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- Plankton: NE-A., p. 11; NW-A., Faroe, p. 37; Cté Atl., Terre-Neuve, p. 47; Manche p. 47; Maroc, p. 49; NNS, p. 87; SNS, p. 121; Baltic, p. 158.
- Benthic Food: Tr. A., p. 144.
- The Fish.** Eggs and Larvae: NE-A., p. 12; NW-A., Faroe, p. 39; NNS, p. 99; Tr. A., p. 145; Baltic, p. 158.
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Preface.

At the meeting of the International Council for the Exploration of the Sea at Edinburgh in 1949, it was resolved to establish a Herring Committee under the Chairmanship of Dr. W. C. HOBGSON. All reports on herring investigations will, therefore, from now on be published separately under the heading "Herring" (see pages 162 and following).

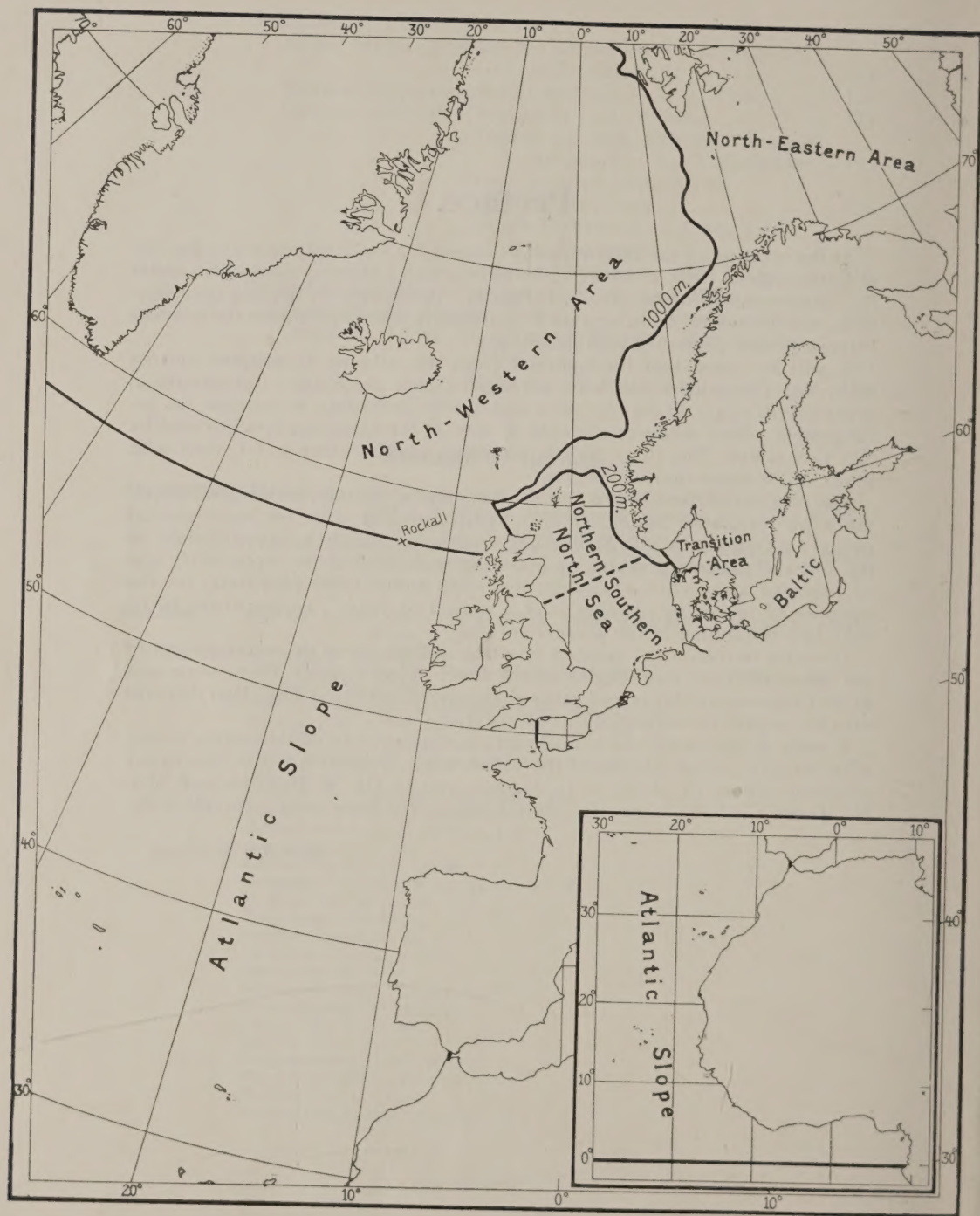
It will be noted that the material from the Atlantic Committee and its three Sub-Committees has been arranged partly according to geographical areas (Hydrology, Plankton, etc.) and partly according to species, an arrangement which seems reasonable in view of the extended area covered by this Committee. The three Sub-Committees, on the other hand, deal with many of the same marine species.

The original purpose of the *Annales Biologiques*, namely, to publish "a summary of correlated biological and hydrographical data for each annual period 1st October to 30th September, containing mainly a record of data, in the form of summary tables and/or diagrams, with short explanatory text as required and, when available, including comparable past data, for the purpose of reviewing changes over a period of years", seems to me to be very nearly fulfilled in the present volume.

In order to obtain the greatest possible uniformity in the arrangement of the material I have reproduced, on the cover of this volume, the scheme sent to all Chairmen of Areas and other Committees in 1945. I hope that this will also be helpful to readers of this publication.

I wish to thank all the contributors for their ready collaboration in our effort to give a clear picture of the year's work. Thanks are also due to my assistant editor, Dr. AAGE J. C. JENSEN and to Dr. M. REHDER and Mrs. H. HARDER, of the Council's central office, for their very valuable help.

HARALD BLEGVAD.



The Areas and their Limits.

North-Eastern Area.

ENVIRONMENT.

Hydrography.

Notes on the Fishery and Bottom Temperatures in the Barents Sea.

During the month of June 1949 a cruise was carried out in the Barents Sea by M/S "Vardholm", a fishery vessel leased for fishery investigations in this area. The chart Fig. 1 shows the working stations.

The following hydrographic sections were worked:

1. Norway—Bear Island, June 2.—3.
2. Bear Island westwards, June 3.
3. Bear Island towards the ice border off South Cape, Spitsbergen, June 4.
4. Across Icefjord Bank, Spitsbergen, June 9.—10.
5. Magdalena Bay eastwards, June 13.
6. Bear Island—Skolpen Bank, June 17.—19.

Further hydrographic work was carried out in the North—Eastern Area on June 29.—July 2. when a section was worked between Norway and Jan Mayen.

Besides the hydrographic work fishing experiments were also carried out in the Barents Sea. Of particular interest for the commercial fishery are the temperature conditions at the bottom in the area of fishing. Fishing boats from several nations are annually working in early summer on the western slope of the Bear Island fishing grounds. In this area both trawlers and longliners work their gear, usually in depths between 200 and 300 metres.

For a series of years the Norwegian Institute of Marine Research has taken hydrographic sections across the bank west of Bear Island and at the same time investigated the fishing conditions. In Fig. 2 is shown a series of temperature diagrams taken in this locality in different years. The bottom on the edge of the shelf, where the fishery is normally carried out, is indicated with black on the diagrams.

In 1938, when the fishery on the Bear Island Bank was rather good, the bottom temperatures were rather high, i.e. between 4 and 5°C. on the edge of the shelf in early May. In the years after the last world war the temperature conditions were rather adverse for the fishery on the Bear Island Banks. The commercial fishery did not give satisfactory results in the years 1946, 1947 and 1948, at least, as far as longlining was concerned. On June 15. 1946, the temperature at the bottom on the slope of the shelf was below 2°C. On July 11. 1947 and June 24. 1948 the bottom water on

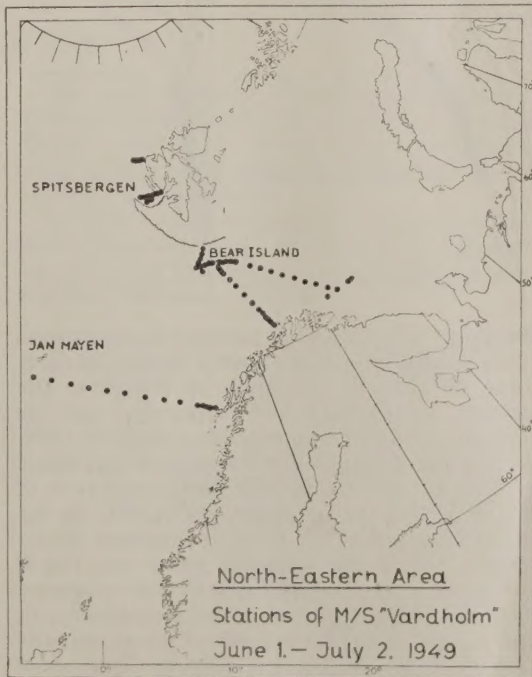
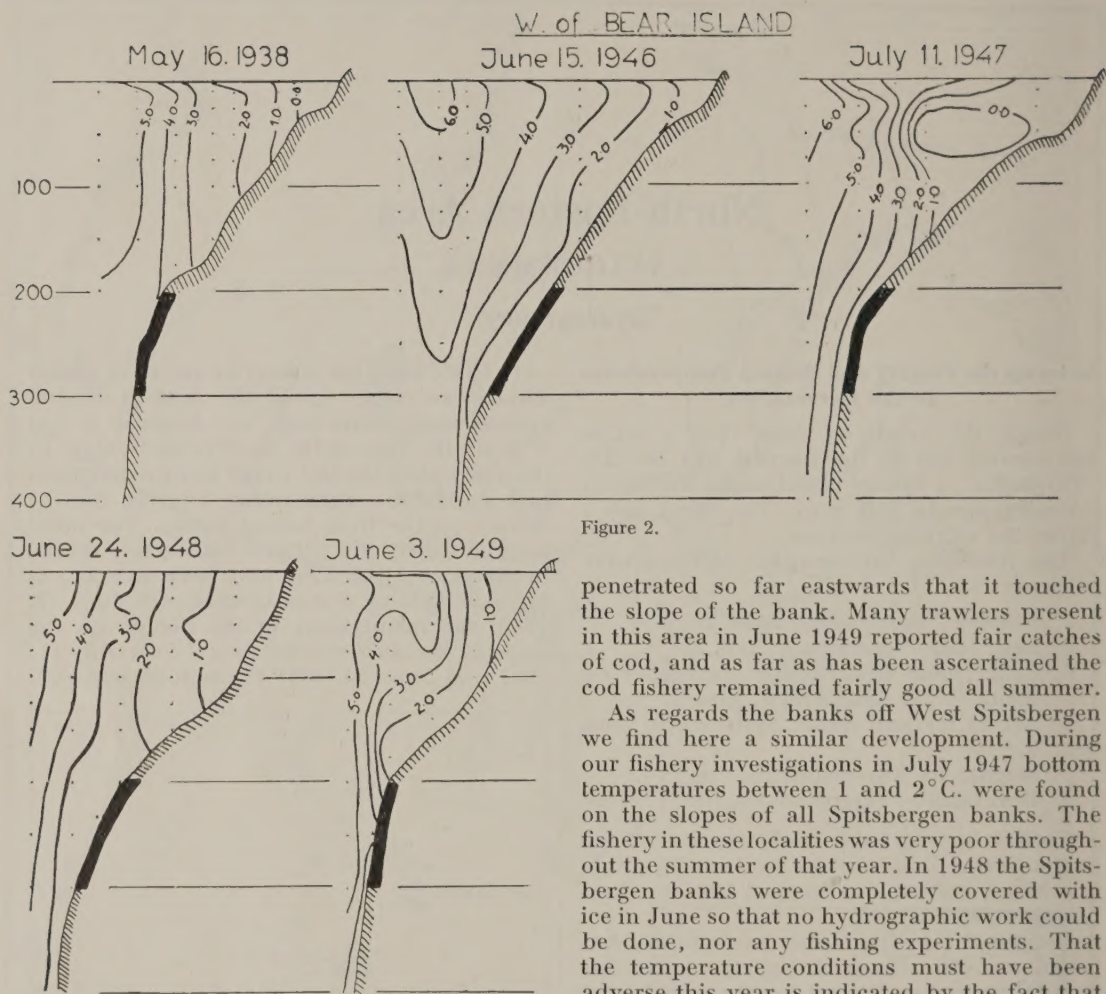


Figure 1.



the slope was somewhat warmer and temperatures slightly above 2°C . were found. In early June of 1949 the situation in regard to the bottom temperature had improved, and we find the conditions approaching those of 1938. At a depth of 250 metres a bottom temperature of 4.25°C . was found and the greater part of the slope had temperatures above 3°C . in the usual fishing depths. A set of longlines in the locality where the warmest water was found gave a very satisfactory catch of cod compared to those of the last few years. Apparently, in early June of 1949, the body of warm Atlantic water usually found at a varying distance off the western part of the Bear Island Bank had

penetrated so far eastwards that it touched the slope of the bank. Many trawlers present in this area in June 1949 reported fair catches of cod, and as far as has been ascertained the cod fishery remained fairly good all summer.

As regards the banks off West Spitsbergen we find here a similar development. During our fishery investigations in July 1947 bottom temperatures between 1 and 2°C . were found on the slopes of all Spitsbergen banks. The fishery in these localities was very poor throughout the summer of that year. In 1948 the Spitsbergen banks were completely covered with ice in June so that no hydrographic work could be done, nor any fishing experiments. That the temperature conditions must have been adverse this year is indicated by the fact that Norwegian fishing vessels found no fish at Spitsbergen later in the summer. In early June of 1949 the ice pack was lying 50–60 miles off the coast of southern Spitsbergen and it was not possible to reach the bank here. But further north the tip of the Icefjord Bank was free from ice. The bottom temperatures here were between 3 and 4°C . on the edge of the bank in depths between 175 and 240 metres. Experiments here with longlines at various stations gave, however, no results. Apparently the cod had not yet reached the Spitsbergen banks in their northward migration although the temperature conditions should have been no hindrance. Commercial longliners fishing the banks here later in summer observed that

the cod had arrived by then although the catches were not particularly rich.

Further north on the Spitsbergen coast we noted an improvement in the temperature conditions in the sea in 1949. At about the middle of June a hydrographic section was worked off Magdalene Bay at 79°40' N. Lat. On the slope of the bank here the bottom temperatures were about 3°C. On this occasion we sailed as far north as 80° N. Lat. without sighting the ice pack. Norwegian whale catchers reported that they had been, in early June, as far north as 81° N. Lat. without sighting the ice pack, a rather unusual feature so early in the summer. Apparently large masses of warm Atlantic water, which had penetrated unusually far north in early spring that year, had helped in breaking up the ice fields.

During the latter half of June hydrographic work was carried out between Bear Island and the Skolpen Bank. The slope of the bank east of Bear Island was covered with cold water with temperatures below 1°C. in depths between 200 and 400 metres. At a distance of about 55 naut. miles east of Bear Island the bottom water became warmer and had tempe-

ratures above 2°C. From this point to the Skolpen Bank was found an extensive body of water with temperatures between 2° and 5°C. On the Skolpen Bank proper the bottom temperature was about 2.8°C. in depths between 170 and 180 metres. Fishing with long-lines were tried (position 71°13'E. 35°30') but the catch of cod was rather small, a result probably partly due to the poor quality of the bait used. At the same time reports were received that good catches of large cod were being made at the Kildin Bank south of our position.

The general impression gained during the 1949 fishery investigations in these northern waters is that the temperature conditions had improved considerably compared with the last few years. The observations indicate that a large body of salt and warm Atlantic water penetrated far to the east and north in the Barents Sea in 1949. Although the temperature conditions decidedly affect the fishery it is, however, undeniable that other factors also play an important part in determining the occurrence of cod on the fishing grounds.

BIRGER RASMUSSEN.

PLANKTON

Zooplankton Investigations in Western Norway during 1949.

In 1949 investigations were initiated in some fjords on the west coast of Norway in order to study the production of zooplankton. (For location, see map Fig. 3.)

The stations, 6 in all, were visited 4 times in the period April 28.—July 17. Vertical hauls with a Nansen net "8/72" were made from 50 m. to the surface. Some hauls were also made from 150–50 m.

Early in May the average total number of all organisms was 2000, all stations taken together. At the beginning of June the number had increased to 140,000. On June 23., the number had decreased to about 2000. Later on the number again increased and had reached about 4500 in the middle of July.

The average volume of plankton was 3 cc. at the beginning of May and increased to 5 cc. early in June. Three weeks later the volume had decreased to 2 cc., but showed a second increase in the middle of July, when it again reached 5 cc.

The most common calanoid copepods were *Calanus finmarchicus*, *Pseudocalanus minutus*, *Temora longicornis*, *Metridia longa* and *lucens*, *Acartia longiremis* and *clausi*, *Oithona helgolandica* and *spirostris*.

In addition to the copepods some other organisms occurred, e.g. Cladocera, Cyphonautes, larvae of Euphausiacea, Coelenterata, Cirripedia, Mollusca, Copelata.



Figure 3. Chart showing Areas • Stations.

The investigations will be continued during 1950. If possible, samples will be taken every fortnight.

KAARE R. GUNDERSEN.

Scottish Work.

Amongst the most noticeable features of the plankton sampled in the area was the presence of the oceanic forms *Sagitta serratodentata*, *Rhincalanus nasutus*, *Thysanoessa longicaudata*, and *Sagitta elegans* towards the entrance to the Skagerak in January and April, and the general tendency for *Sagitta elegans* to be distributed more on the eastern side of the North Sea in spring than in summer or autumn.

The following deep water species were found wintering in the area: - *Calanus hyperboreus*, *Metridia longa*, *Euchaeta norvegica*, *Euchaeta hebes*, *Heterorhabdus norvegicus*, *Heterostylites longicornis*, *Gaidius tenuispinus*, *Gaidius brevispinus*, *Stylocheiron elongatum*, *Meganyctiphanes norvegica*, *Scina borealis*, *Calocaris anonyx*, and *Dimophyes arctica*.

The oceanic medusae *Pelagia perla* and *Chromatonema rubrum*, and the copepod *Rhincalanus nasutus* occurred there in June, and the edge of an influx containing *Salpa fusiformis*, *Agalmopsis elegans* and *Clione limacina* entering the North Sea round the north of the Shetlands affected the area in September and October.

J. H. FRASER.

THE FISH

The Occurrence of Fish Eggs and Larvae along the Coast of Northern Norway during April-June 1948 and 1949.

In 1947 the Clarke-Bumpus plankton sampler was tried for the first time in Norwegian waters. It proved very useful, especially for the collection of eggs and younger larvae of fish.

During the spring of 1948 and 1949 further investigations were carried out along the coast and on the banks off northern Norway in order to follow the spring increase of the plankton and investigate the quantitative distribution of fish eggs and larvae.

In 1948 the hauls were made only at depths of 10 and 25 metres, but in 1949 we had more samplers at our disposal and three samplers were in use simultaneously, being opened and closed by messengers. The samplers were fastened to the hydrographic wire, at the end of which was hung a weight of 32 kilogrammes. The samplers were towed at a speed of approximately 2–3 knots, holding the wire at a constant angle of 50 degrees with the vertical. The nets were made of silk No. 2. The hauls were taken in steps, the samplers working from 75 to 55 metres, 50–30 m. and 25–5 m. respectively, being raised 5 metres every 4 minutes. Owing to the seas it proved difficult to tow the sampler immediately below the surface. In a 20 minutes' haul the amount of water filtered generally varied between 5000 and 13000 litres.

The figures for the year 1948 were calculated per 10 m³, as the average value of the hauls at 10 m. and 25 m. taken together; for 1949 as numbers below one square metre of surface.

Cod. *Gadus callarias*. The arctic cod or "skrei" has its main spawning area along the coast of Norway from Lofoten to Sørøya in the period January–April with maximum spawning in the middle of March.

The coastal cod spawns in the same areas and at the same time, but is scarce in the Lofoten area compared with the skrei. 1948. In the latter half of April there were from 10 to 150 cod larvae per 10 m³, in the upper 25 metres in the Lofoten area (Fig. 4). Most of the larvae still possessed a yolk sack and must have been hatched very recently. The average size was 5.1 millimetres. In addition, cod eggs were present, somewhat more numerous than the cod larvae (Fig. 4). One month later the number of larvae had decreased, (Fig. 5) and the average size was then 12 millimetres.

A few small cod larvae were found on the innermost part of the Fugloybank, indicating that some spawning had taken place not far away. Further north only few of the larger larvae occurred. In the latter half of May several cod larvae were found in the Andfjord, and on the banks a little further north, but no larvae occurred outside the edge.

1949. The investigations started at the beginning of April. Fig. 6 shows the quantitative



Fig. 4. Number of cod larvae (above the line) and of cod eggs per 10 m³. in the Westfjord April 24.—30. 1948.



Fig. 5. Number of cod larvae per 10 m³. in the Westfjord May 28.—June 5. 1948.



Fig. 6. Number of cod eggs below 1 m². of surface in the Westfjord April 7.—9. 1949.

per m².
Dotted area, > 10,000 eggs
Cross-hatched, 5000—10,000 "
Hatched, 1000—5000 "
Broken-hatched, 100—1000 "

distribution of cod eggs in the Westfjord, indicated as numbers below 1 m². of surface. The largest quantities of eggs were found within the 200 m. line in the areas where the maximum spawning is known to take place. In the inner part of the fjord there were more than 5000 eggs pr. m². At some places the numbers exceed 13,000 per m².—but the numbers decreased both inwards and outwards. Most of the eggs were at an advanced stage of development, and some newly hatched larvae also occurred, in numbers up to 100 larvae per m².

The current conditions in the surface layers of the Westfjord are shown on Fig. 7.



Fig. 7. Current conditions in the upper 50 metres of the Westfjord. From EGGVIN.

The coastal current enters the fjord along the south-eastern shore, makes a sharp bend and passes out again off the outermost islands. A current going out of the fjord is also indicated along the 200 metre line. There are eddies in the inner part of the fjord and near the north-western shore. The distribution of cod eggs is in good agreement with the current conditions. We found very few eggs along the south-eastern shore.

Some cod eggs also occurred on the banks off Lofoten, decreasing in numbers towards the edge.

In order to investigate the vertical distribution of cod eggs and larvae some hauls were made in the inner part of the Westfjord on April 20th. The hauls were made at depth intervals of 5 metres. Figures are estimated per 10 m³.

Depth m.	Øksfjord		Økssound	
	eggs	larvae	eggs	larvae
5—10	206	18	832	680
15—20	53	0	735	136
25—30	186	3	123	40
35—40	37	0	85	36
45—50	6	0	3	13

The bulk of both cod eggs and larvae was to be found in the upper 30 metres.

At the beginning of May the number of eggs had decreased to 100—200 per m². but now a great number of cod larvae were found, up to 3000 individuals per m². (Fig. 8). Compared

with the observations in 1948 there were now more larvae per 10 m³ in the upper 25 metres. While many cod larvae were found just inside Røst, very few occurred outside Røst, probably on account of the current conditions. There were some larvae on the banks off Eggum. Many larvae also occurred in the Andfjord and on the banks further north, the numbers always decreasing sharply towards the edge (Fig. 9). North of the Fugløysbank few larvae were found. It may be possible that the currents form a back-eddy in the Andfjord causing cod larvae to be gathered together, though there is also a considerable local spawning here.

Fig. 10 shows the length distribution of cod larvae from different localities from Lofoten and northwards in the first half of May. North of the Andfjord there is a marked increase in length, although the larvae were taken only two days later. We may presume that these larvae are older than the others and have drifted with the currents from localities further south, perhaps from the banks outside Lofoten.

In June the number of cod larvae had decreased considerably. The length distribution was very irregular (Fig. 11) with an average length of 8.8 mm. It may be of some interest that big shoals of saithe, *Gadus virens*, were seen in the Westfjord at the beginning of June. One saithe was caught, and on ex-

amination showed a stomach content almost entirely consisting of cod larvae, more than 1000 individuals, in addition to some other fish larvae. It must be supposed that the saithe is responsible to some extent for the diminuation in number of the cod larvae. Similar observations were made, many years before, on the Fugløysbank. The cod larvae found in the stomach of the saithe were much larger than the larvae caught in plankton nets (see Fig. 11). From this fact we may draw varying conclusions. Firstly, that the larger cod larvae are able to avoid the plankton nets to a very great extent. Secondly, that the saithe makes a certain selection of fish larvae, preferring the larger ones. The real length distribution of the cod larvae has its maximum probably somewhere between the maxima of the two curves.

Haddock. *Gadus aeglefinus*. The main spawning area of the haddock is located in the northern part of the North Sea, and on the banks off Møre. It may be that some spawning also occurs on the banks off Helgeland further north, but very little hitherto is known about these localities. In an unpublished account of some plankton investigations in 1909 EINAR KOEFOED reports finding several eggs and larvae of haddock on the banks off Vesterålen in April–May. Spent haddock were caught at this time on the same banks. In July–August he found pelagic larvae of haddock on the banks farther north.

At the beginning of May 1948 single eggs of haddock were found in the mouth of the Westfjord, and some larvae on the banks outside Vesterålen, Andenes and on Malangsgrunnen (see Fig. 12). In May 1949 only single

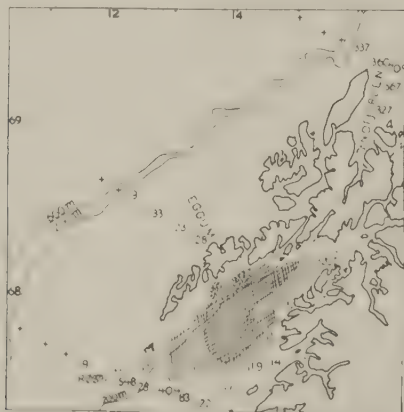


Fig. 8. Number of cod larvae below 1 m² of surface in the Westfjord and the Andfjord. May 2.—7. 1949.

Dotted area,	> 3000 larvae per m ² .
Cross-hatched,	1000—3000 " " "
Hatched,	500—1000 " " "
	+ negative hauls.



Fig. 9. Number of cod larvae per m² from Malangsgrunnen (M) to Nordkapp, May 9.—16. 1949. + negative hauls.

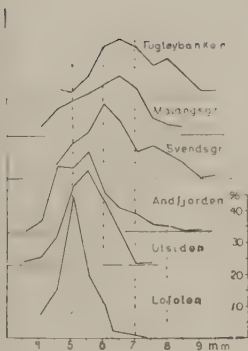


Fig. 10. Length distribution of cod larvae from different localities. May 2.-10. 1949.

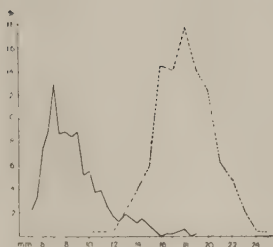


Fig. 11. Length distribution of cod larvae caught in plankton samplers from Malangsrunden to the Westfjord May 31. -June 7. 1949 (drawn line) and of cod larvae from the stomach of a saithe caught in the Westfjord June 7. 1949 (broken line).



Fig. 12. Occurrence of eggs and larvae of haddock (H) and of herring larvae (S) from Vesterålen to Nordkapp. May 28.-June 5. 1948. + negative hauls.

eggs occurred in the Andfjord and outside Andenes, and no larvae were found later in the season. One must presume that the spawning of haddock so far north will vary very much from one year to another. Without drawing any conclusion I will refer to the fact that in the autumn of 1948 there were immense numbers of 0-group haddock in the fjords of Northern Norway. Thousands were caught with the prawn trawl on the deep-sea prawn grounds. In the autumn of 1949 there were practically no 0-group fish, present, but still several of the I-group.

Torsk. *Brosomus brosme*. Single eggs of the torsk were found over the whole of the West-

fjord, Andfjord and on the outer banks as far north as the Fugløysbank in May 1948 and 1949.

Herring. *Clupea harengus*. Earlier investigations (RUNNSTRØM 1934) have shown that there are spawning places for herring off Vesterålen and probably on the Helgelandsbank further south.

A few herring larvae were caught in the last half of April and in the beginning of June 1948 in the southern part of the Westfjord, and in the first half of May outside Andenes and on the Fugløysbank. In 1949 comparatively large numbers of herring larvae were caught at the beginning of April on the banks outside

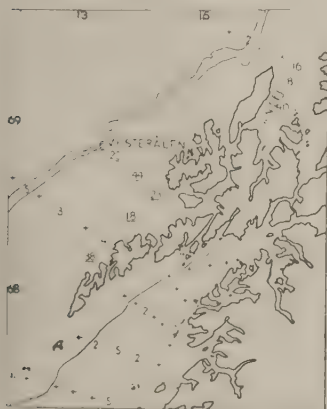


Fig. 13. Number of herring larvae per m², off Vesterålen April 11, and 22. (underlined figures) and in the Westfjord and the Andfjord May 2.-7. 1949. + negative hauls.



Fig. 14. Number of herring larvae per m², from Malangsrunden to Nordkapp May 9.-16. 1949. + negative hauls.



Fig. 15. Number of redfish larvae per 10 m³, in the Westfjord, May 28.-June 5. 1949. + negative hauls.



Fig. 16. Number of caplin larvae per 10 m³, May 14.—25, 1948. The spawning area is indicated. + negative hauls.

Lofoten (Fig. 13), from 6 to 44 larvae per square metre. These larvae were from 12 to 15 mm. long and must have been hatched in the vicinity. A newly hatched herring larva measures from 7 to 10 mm. In the Westfjord no larvae appeared until the beginning of May, and were then found in the outer and southern parts. In May a good number of herring larvae were found in the Andfjord, a maximum of 40 larvae per m². (Fig. 14). Single larvae occurred further north. A local spawning ground of herring is also known in the Kvefjord inside the Andfjord.

Redfish. *Sebastes marinus*. On Fig. 15 is shown the occurrence of larvae of redfish in 1948. The larvae did not appear in the plankton until the latter half of May, but were then evenly distributed and numerous inside and outside the edge.

In 1949 single larvae occurred in the inner part of the Westfjord at the beginning of April. One month later there were many larvae here and single larvae were spread all over the fjord and also outside the Lofoten islands. In June there were still more larvae. North of the Andfjord very few larvae were found during the investigations.

Caplin. *Mallotus villosus*. According to RASS (1936) there are three races of caplin. 1) The Finmark or spring caplin which spawns off Finmark and the Murman coast in March—April, 2) the summer caplin which spawns in June—July along the eastern part of the Murman coast and in the Cheshskaya Bay, and

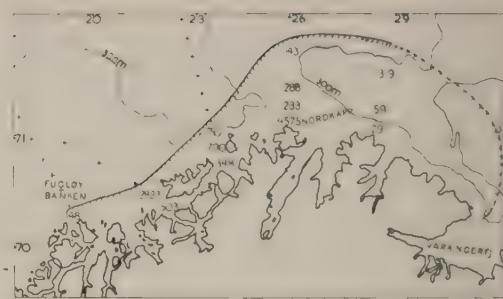


Fig. 17. Number of caplin larvae per m², May 15.—24, 1949. The spawning area is indicated. + negative hauls.

3) the autumn caplin which comes to Novaja Semlja in August—September.

In the latter half of May 1948 many caplin larvae were found near the shore from Nordkapp and eastwards, in some places numbering 160 larvae per 10 m³. in the upper 25 m. The larvae were all concentrated near the shore. They were newly hatched and the occurrence therefore indicates the spawning area of the caplin (Fig. 16).

In 1949 the area was investigated at about the same time as in 1948, and many larvae were found, but the spawning area now extended further southwards, to the Fugløybank (Fig. 17). It was difficult to determine the eastern limit of the spawning area, as there were few observations here. Since more larvae occurred per 10 m³. than in 1948, one might perhaps presume that the hatching had started earlier.

According to RASS (1936) the larvae are not found in great quantity in the plankton until the middle of June.

Plaice. Single eggs and larvae occurred over the whole Westfjord in April and May of both years.

KR. FRED. WIBORG.

Literature:

- RASS, TH. 1936. Spawning, eggs and fry of the food-fishes of the Barents-Sea etc. Int. Rev. d. ges. Hydrobiol. und Hydr. 33. Leipzig.
 RUNNSTRÖM, S. 1934. The pelagic distribution of herring larvae in the Norwegian waters. Rapp. et Proc. - Verb. Vol. LXXXVIII.

North-Western Area.

INTRODUCTION.

The contributors to this report from the North-Western Area are:

Dr. J. H. FRASER, Aberdeen.
Dr. PAUL M. HANSEN, Copenhagen.
Mr. A. D. McINTYRE, Aberdeen.
Cand. JÓN JÓNSSON, Reykjavik.
Cand. A. KILLERICH, Copenhagen.
Dr. BENNET B. RAE, Aberdeen.
Mr. BIRGER RASMUSSEN, Bergen.
Cand. JENS SMED, Copenhagen.
Mr. A. SAVILLE, Aberdeen.
Cand. UNNSTEINN STEFÁNSSON, Reykjavik.

It is still very difficult in this huge area to maintain continuous survey of all waters by the research vessels in commission. Some promising improvements are however in progress, new vessels for research in both Iceland and Greenland waters should appear during the coming years, and the available vessels will, according to programmes, pay more attention both to these waters and also to the Faroe waters. It is accordingly to be hoped that progress on a greater scale will be seen in the near future.

1. Environment.

With the present contribution to the hydrography of the area Mr. JENS SMED has finished his review of the monthly anomalies of the surface temperature in northern waters. The increase in temperature during the present

period is obvious in practically all localities studied, with however a few exceptions towards the southern boundaries. Special reviews of the Iceland and Greenland waters are given by A. KILLERICH, BIRGER RASMUSSEN and UNNSTEINN STEFÁNSSON, partly as continuations of reports in previous volumes of Ann. Biol., partly as contributions showing more or less local fluctuations which might in some cases indicate a change towards lower temperatures in the area.

2. Plankton and Fish.

The condition of the macroplankton in the Faroes during 1949 is reviewed by Dr. FRASER with reference to a general account given in the Northern North Sea Area report.

A general review on the occurrence of important fish eggs and larvae in Faroe waters is given by Mr. A. SAVILLE.

Of fish only the halibut statistics from the whole area (by McINTYRE), the cod in Iceland and Greenland waters (by JÓN JÓNSSON, BIRGER RASMUSSEN and PAUL M. HANSEN) and the lemon sole in Faroe waters (by B. B. RAE) are considered. Unfortunately it is evident that most of the laboratories involved are prevented by lack of sufficient scientific staff from devoting the necessary time to the elaborate work required for up-to-date reviews of the most important fish stocks.

Å. VEDEL TÅNING.

ENVIRONMENT.

Hydrography.

Monthly Anomalies of the Surface Temperature in Areas of the northern North Atlantic during the Years 1876-1939 and 1945-1949.

In previous reports (see legend to Fig. 4) monthly anomalies of the surface temperature during a period of years were given for a number of areas of the northern North Atlantic. In the present paper these investigations are extended to the areas L, M and N (see Fig. 1), viz. L, 55° – 60° N., 10° – 20° W.; M, 55° – 60° N., 20° – 30° W.; and N, 50° – 55° N., 20° – 30° W.

The data used were collected by the Danish Meteorological Office. The data for the years 1912–1949 were compiled from the *Nautisk-Meteorologisk Aarbog* while the data for the years 1876–1911 were kindly placed at my disposal by Mr. HELGE THOMSEN, Head of the Nautical Section of the Danish Meteorological Office.

The available data consisted of temperature means for each month and each 1° -square. These means were compared with the grand monthly means for the period 1876–1915, published by RYDER (1917). The anomalies computed in this way were then averaged over each of the areas, L, M, and N. For details of the calculation the reader is referred to the previous papers cited above.

The results are given in Tables 1–3, where the monthly anomalies are recorded together with the numbers of observations on which

they are based. A graphic presentation of the results is given in Figs. 2 and 3. It is seen from the tables and the graphs that since about 1932 positive anomalies have been predominant in area L and, to a minor degree, in area M. This is in accordance with the conditions found in other areas of the north-eastern North Atlantic (areas H, J, and K). On the other hand, there is no apparent predominance of positive anomalies in the southernmost area (N) in this period. This is in accordance with the findings for the neighbouring western area (E). Although during the war years no observations were available from the areas considered there are some data for the post-war years. On the

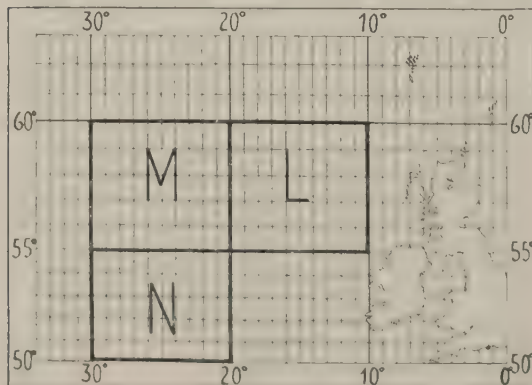


Fig. 1. Location of Areas considered.



Fig. 4. Location of Areas and Stations considered in this Series of Reports. The various localities have been discussed in previous issues of the *Annales Biologiques*: Areas A and B, Vol. II; A–E, Vol. III; F–I, Vol. IV; J and K, Vol. V; Stations Ve, St, Gr, and Pa, Vol. IV.

basis of these data the anomalies recorded in Table 4 were calculated. Positive anomalies are still obviously predominating in area L. In area M, however, negative anomalies predominated in 1949.

Thanks are due to Mrs. POULA HOLM and Mr. P. ALNØE for carrying out the calculations.

JENS SMED.

Literature.

Nautisk-Meteorologisk Aarbog, 1912–1949. København.
 RYDER, 1917. Monthly Mean Temperatures of the Surface Water in the Atlantic, North of 50° N. Lat. (App. to Naut.-Meteor. Aarbog). Copenhagen.

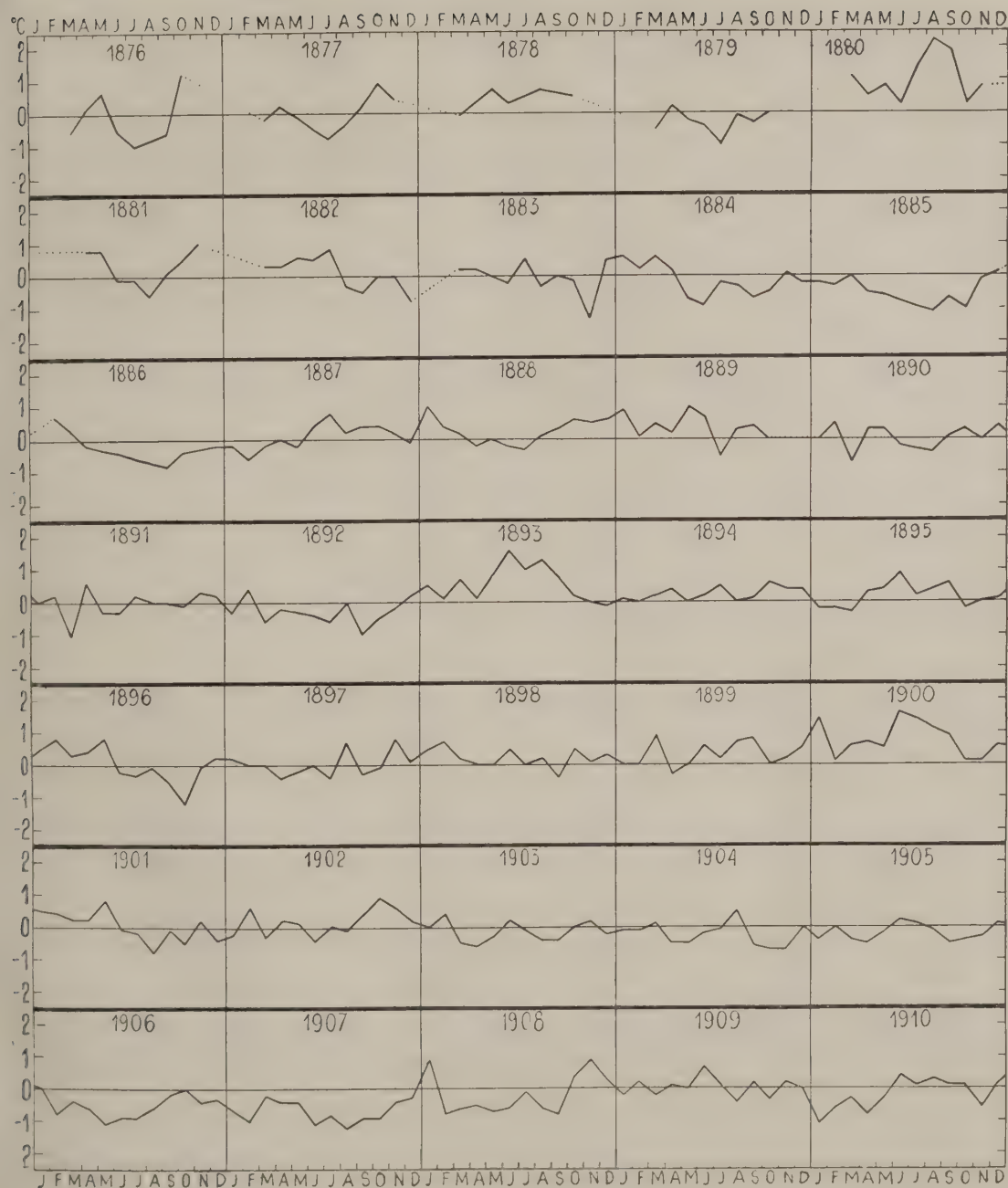


Fig. 2 a. Monthly Anomalies of the Surface Temperature in the Area L (see Fig. 1) during the Years 1876—1910.

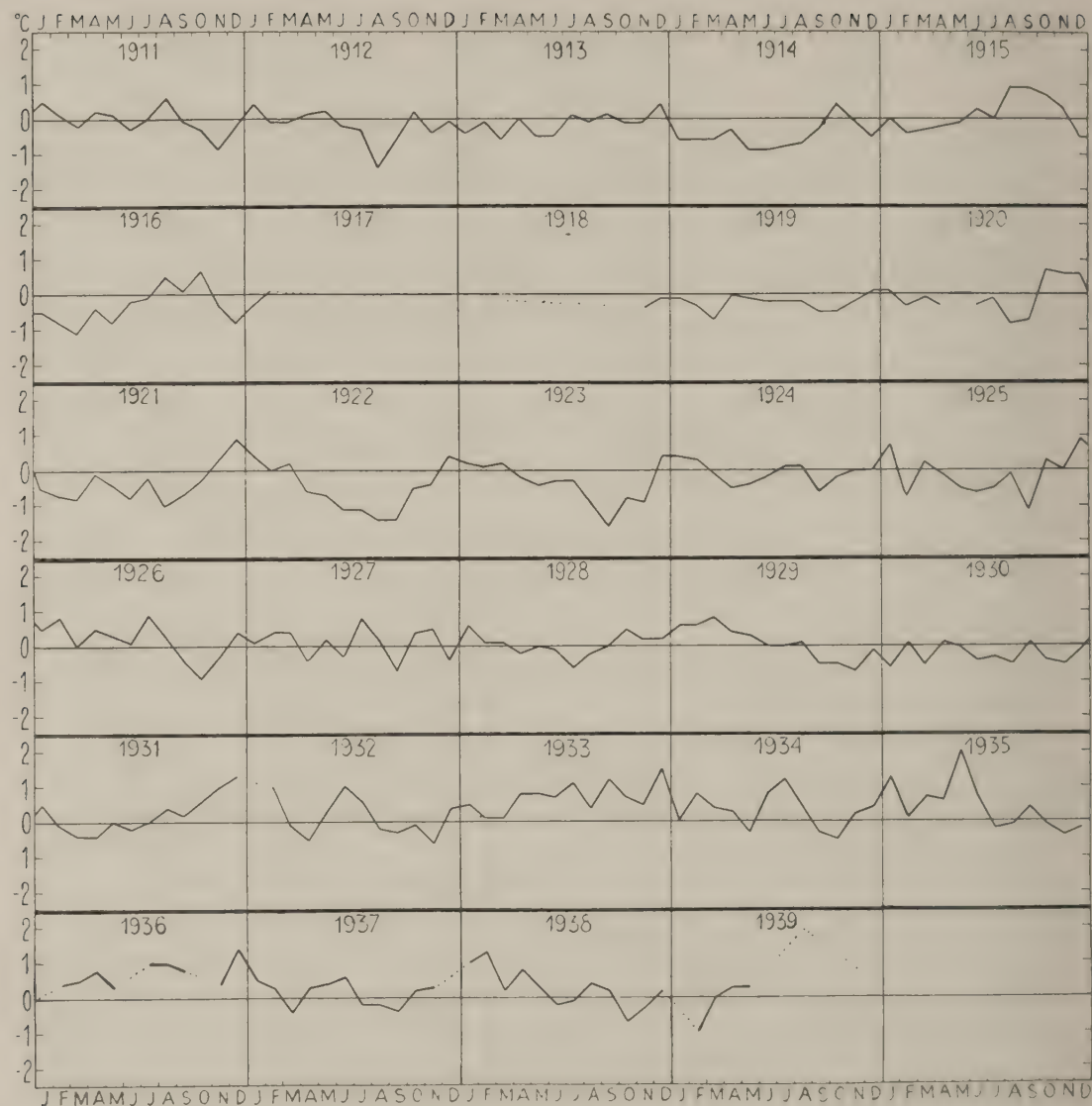


Fig. 2 b. Monthly Anomalies of the Surface Temperature in the Area L (see Fig. 1) during the Years 1911–1939.

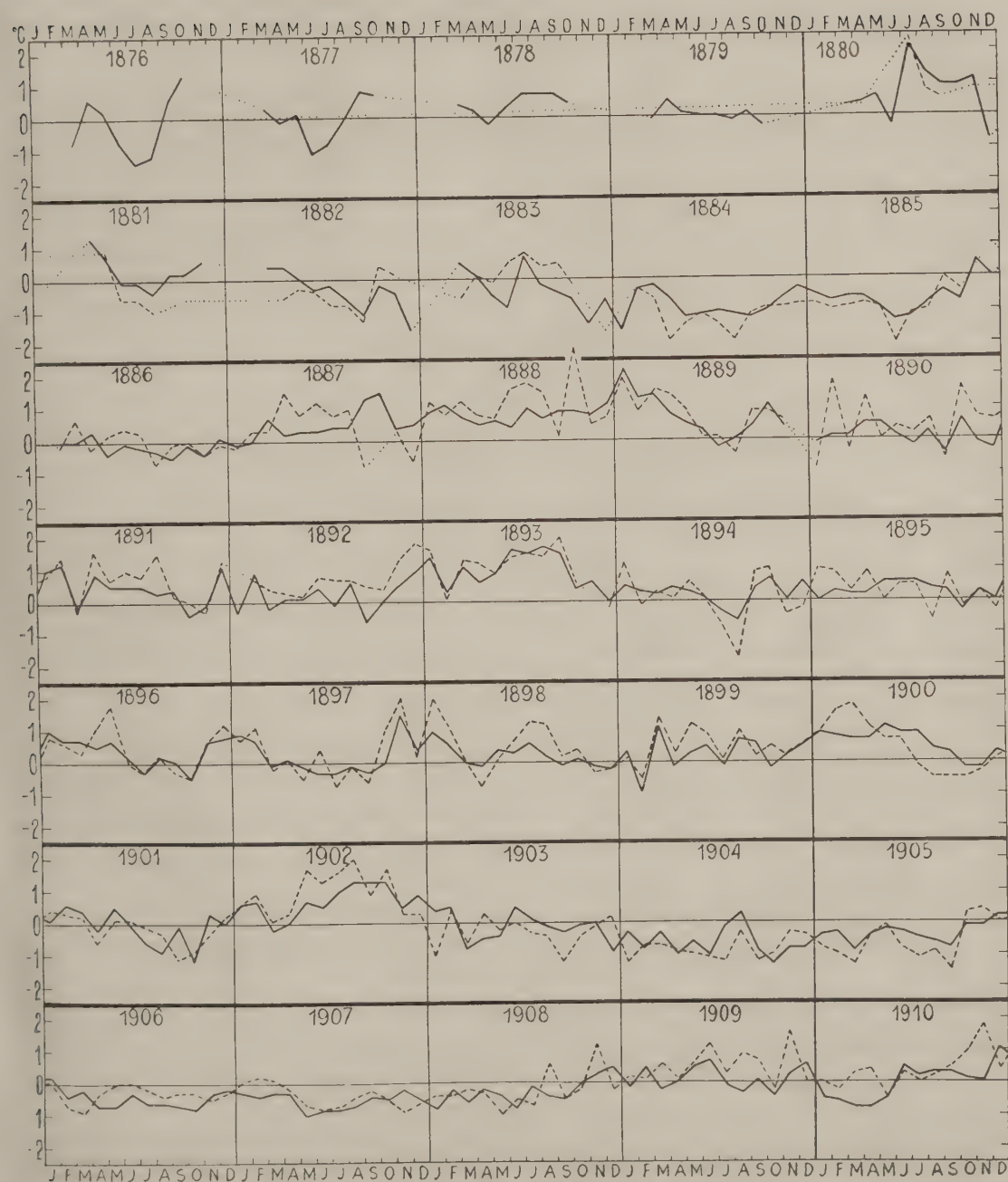


Fig. 3 a. Monthly Anomalies of the Surface Temperature in the Areas M and N (see Fig. 1) during the Years 1876—1910. Solid lines, Area M; dashed lines, Area N.

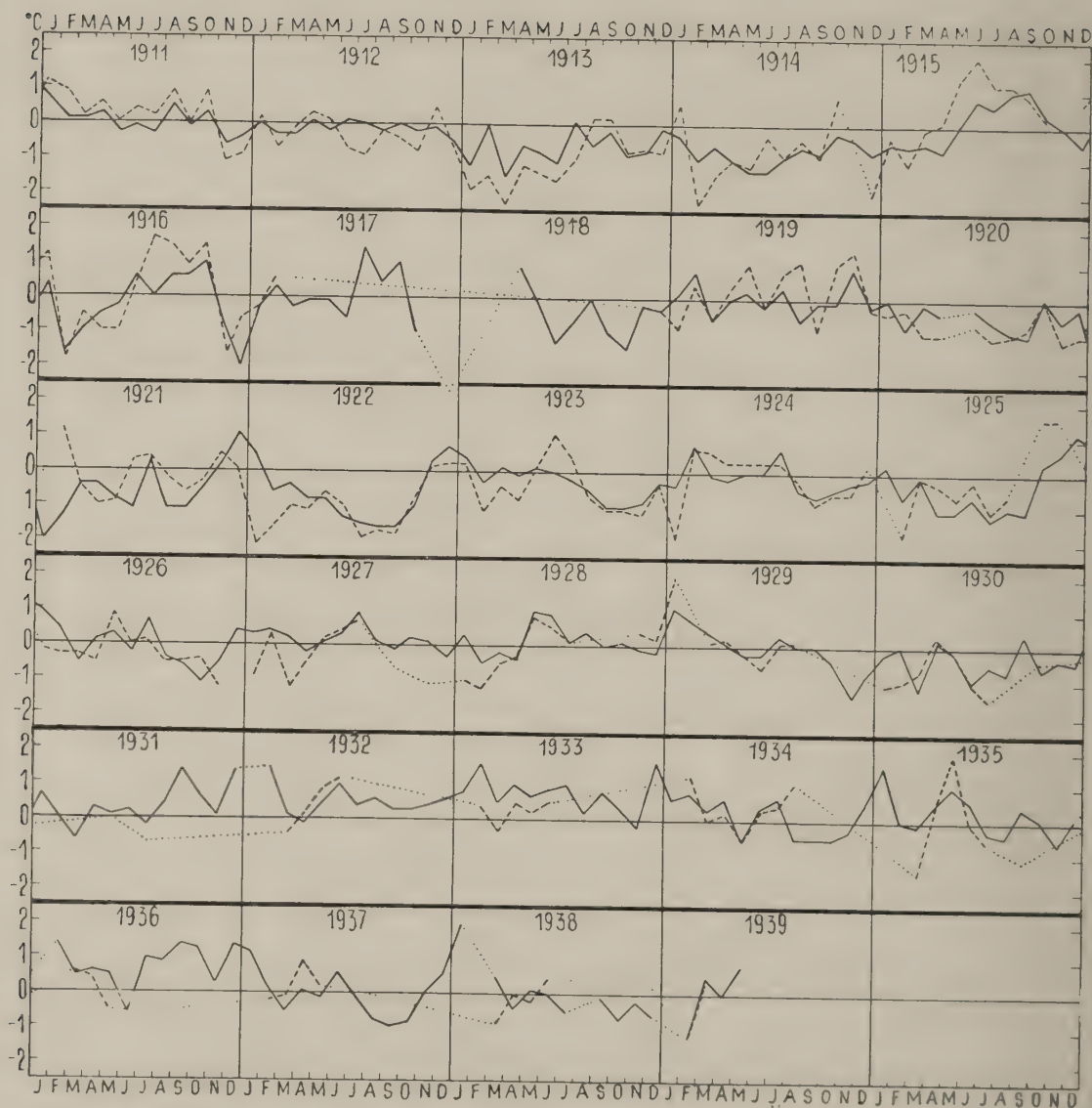


Fig. 3b. Monthly Anomalies of the Surface Temperature in the Areas M and N (see Fig. 1) during the Years 1911–1939. Solid lines, Area M; dashed lines, Area N.

In Fig. 4 the areas and stations are indicated from which data have been discussed in this series of reports. The calculations will not be extended to further localities of the northern North Atlantic as the available data for such

localities are considered insufficient to give any reliable result. On the other hand it is intended to discuss the future data from the localities indicated in Fig. 4, in the relevant issues of the *Annales Biologiques*.

Tables 1a & 2a. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Areas L and M (see Fig. 1) during the Years 1876-1895. (1896-1939 see following pages).

Area L.	January	February	March	April	May	June	July	August	September	October	November	December
	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n
1876	—	—	-0.6 4	0.1 6	0.6 12	-0.5 60	-1.0 11	-0.8 17	-0.6 21	1.2 51	—	—
1877	—	—	-0.2 22	0.2 24	-0.1 47	-0.5 16	-0.8 57	-0.4 13	0.1 35	0.9 17	0.4 9	—
1878	—	—	-0.1 9	0.3 27	0.7 46	0.3 30	0.5 24	0.7 29	0.6 47	0.5 33	—	—
1879	—	—	-0.5 14	0.2 38	-0.2 68	-0.4 29	-1.0 11	-0.1 26	-0.3 41	0.0 4	—	—
1880	—	—	1.1 20	0.5 23	0.8 43	0.2 39	1.4 45	2.2 36	1.9 58	0.2 24	0.8 2	—
1881	—	—	—	0.8 23	0.8 64	-0.1 60	-0.1 34	-0.6 45	0.1 37	0.5 30	1.0 8	—
1882	—	—	0.3 10	0.3 63	0.6 48	0.5 79	0.8 46	-0.3 58	-0.5 69	0.0 36	0.0 12	-0.8 18
1883	—	—	0.2 12	0.2 51	0.0 45	-0.2 87	0.5 52	-0.3 51	0.0 65	-0.1 38	-1.3 9	0.5 18
1884	0.6 10	0.2 18	0.6 19	0.2 47	-0.7 74	-0.9 111	-0.2 51	-0.3 53	-0.7 71	-0.5 65	0.1 22	-0.2 27
1885	-0.2 33	-0.3 33	0.0 24	-0.5 57	-0.6 126	-0.8 65	-1.0 62	-1.1 34	-0.7 107	-1.0 76	-0.1 18	0.1 29
1886	—	0.7 7	0.3 17	-0.2 64	-0.3 79	-0.4 75	-0.6 82	-0.7 57	-0.8 97	-0.4 101	-0.3 42	-0.2 33
1887	-0.2 26	-0.6 25	-0.2 51	0.0 73	-0.2 76	0.4 139	0.8 89	0.2 86	0.4 85	0.2 61	0.4 88	-0.1 31
1888	1.0 12	0.4 15	0.2 22	-0.2 43	0.0 79	-0.2 115	-0.3 79	0.1 73	0.3 82	0.6 51	0.5 49	0.6 30
1889	0.9 33	0.1 17	0.5 37	0.2 27	1.0 45	0.7 46	-0.5 37	0.3 56	0.4 60	0.0 9	—	—
1890	0.0 15	0.5 6	-0.7 16	0.3 24	0.3 73	-0.2 53	-0.3 55	-0.4 85	0.1 61	0.3 38	0.0 48	0.4 9
1891	0.0 19	0.2 8	-1.1 19	0.6 43	-0.3 100	-0.3 78	0.2 44	0.0 61	0.0 100	-0.1 55	0.3 30	0.2 43
1892	-0.3 11	0.4 11	-0.6 24	-0.2 31	-0.3 81	-0.4 110	-0.6 61	0.0 90	-1.0 104	-0.5 59	-0.2 55	0.2 52
1893	0.5 37	0.1 15	0.7 36	0.1 46	0.8 98	1.6 82	1.0 78	1.3 72	0.8 108	0.2 102	0.0 50	-0.1 56
1894	0.1 34	0.0 41	0.2 32	0.4 66	0.0 86	0.2 97	0.5 58	0.0 47	0.1 63	0.6 63	0.4 38	0.4 36
1895	-0.2 24	-0.2 25	-0.3 29	0.3 50	0.4 64	0.9 93	0.2 90	-0.4 99	0.6 133	-0.2 53	0.0 67	0.1 53

Area M.	January	February	March	April	May	June	July	August	September	October	November	December
	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n
1876	—	—	-0.8 9	0.6 17	0.2 6	-0.7 77	-1.4 12	-1.2 14	0.5 51	1.3 33	—	—
1877	—	—	0.3 29	-0.1 41	0.1 48	-1.1 11	-0.8 58	-0.1 20	0.8 39	0.7 18	—	—
1878	—	—	0.4 2	0.2 61	-0.2 49	0.3 42	0.7 28	0.7 23	0.7 46	0.4 35	—	—
1879	—	—	-0.1 9	0.5 52	0.1 66	0.0 39	0.0 30	-0.1 66	0.1 23	-0.3 7	—	—
1880	—	—	0.3 5	0.4 57	0.6 80	-0.3 48	2.1 44	1.3 52	0.9 45	0.9 27	1.1 1	-0.8 1
1881	—	—	—	1.3 38	0.7 73	-0.1 44	-0.1 44	-0.4 46	0.2 52	0.2 24	0.6 2	—
1882	—	—	0.4 6	0.4 65	0.0 43	-0.3 68	-0.2 23	-0.6 78	-1.1 47	-0.2 41	-0.4 13	-1.6 2
1883	—	—	0.5 9	0.1 58	-0.5 38	-0.9 54	0.7 29	-0.2 42	-0.4 48	-0.6 27	-1.4 8	-0.6 15
1884	-1.6 8	-0.3 9	-0.2 14	-0.6 48	-1.2 43	-1.1 86	-1.0 46	-1.1 72	-1.2 55	-1.0 58	-0.6 25	-0.3 20
1885	-0.5 40	-0.7 22	-0.6 15	-0.6 60	-0.9 78	-1.3 46	-1.2 74	-0.8 36	-0.4 80	-0.7 63	0.5 27	0.0 16
1886	—	0.0 6	0.0 6	0.3 46	-0.4 60	-0.1 67	-0.2 66	-0.3 43	-0.5 84	-0.1 70	-0.4 44	0.1 21
1887	-0.1 19	0.0 17	0.7 16	0.2 31	0.3 42	0.3 77	0.4 38	0.4 79	1.3 72	1.5 49	0.4 37	0.5 36
1888	0.9 9	1.1 10	0.7 12	0.5 25	0.6 44	0.4 93	1.0 53	0.7 72	0.9 39	0.9 49	0.8 18	1.1 31
1889	2.2 7	1.3 22	1.4 14	0.8 22	0.5 32	0.3 60	-0.2 32	0.0 61	0.4 50	1.1 12	0.4 9	—
1890	-0.1 15	0.1 9	0.1 6	0.5 9	0.5 51	0.1 60	-0.2 20	0.2 49	-0.4 41	0.6 34	-0.1 22	-0.3 17
1891	1.0 14	1.2 1	-0.2 5	0.9 29	0.5 52	0.5 56	0.5 23	0.3 68	0.4 87	-0.4 39	-0.1 30	1.1 40
1892	-0.3 7	0.9 13	-0.2 10	0.1 36	0.1 44	0.4 60	-0.1 53	0.6 59	-0.6 82	0.0 54	0.5 54	0.9 51
1893	1.4 27	0.3 3	1.1 18	0.6 53	0.9 64	1.6 61	1.5 80	1.7 62	1.5 114	0.4 49	0.6 35	0.0 41
1894	0.5 30	0.3 24	0.2 16	0.4 58	0.3 46	0.1 81	-0.3 57	-0.6 37	0.4 73	0.7 72	0.0 34	0.6 33
1895	0.0 22	0.3 21	0.2 16	0.2 45	0.6 47	0.6 68	0.6 55	0.4 67	0.3 107	-0.3 48	0.3 58	0.0 39

Table 1. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Area L (see Fig. 1) during the Years 1896-1939.

Area L	January	February	March	April	May	June	July	August	September	October	November	December
	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n
1896	0.5 58	0.8 45	0.3 46	0.4 52	0.8 46	0.2 108	-0.3 71	-0.1 82	-0.5 105	-1.2 71	-0.1 65	0.2 47
1897	0.2 37	0.0 56	0.0 28	-0.4 126	-0.2 82	0.0 81	-0.4 92	0.7 81	-0.3 92	-0.1 97	0.8 60	0.1 45
1898	0.5 18	0.7 18	0.2 46	0.0 49	0.0 135	0.5 100	0.0 86	0.2 151	-0.4 100	0.5 129	0.1 59	0.3 52
1899	0.0 39	0.0 25	0.9 42	-0.3 87	0.0 100	0.6 104	0.2 113	0.7 112	0.8 109	0.0 101	0.2 103	0.5 58
1900	1.4 8	0.1 9	0.6 54	0.7 74	0.5 112	1.6 92	1.4 63	1.1 130	0.9 134	0.1 80	0.1 80	0.6 51
1901	0.5 60	0.4 38	0.2 90	0.2 107	0.8 80	-0.1 150	-0.2 116	-0.8 92	-0.1 118	0.5 75	0.2 55	-0.4 68
1902	0.2 59	0.6 37	-0.3 79	0.2 83	0.1 113	-0.4 143	0.0 134	-0.1 102	0.4 117	0.9 58	0.5 55	-0.2 82
1903	0.0 47	0.4 55	-0.5 73	-0.6 107	-0.3 104	0.2 108	-0.1 159	-0.4 98	-0.4 111	0.0 104	0.2 79	-0.2 90
1904	0.1 41	-0.1 73	0.1 74	-0.5 119	-0.5 85	0.2 127	-0.1 111	0.5 107	-0.6 70	-0.7 99	-0.7 80	0.0 65
1905	0.4 45	0.0 43	-0.4 68	-0.5 54	-0.2 71	0.2 60	0.1 72	-0.1 91	-0.5 66	-0.4 52	-0.3 44	0.1 27
1906	0.0 31	0.8 33	-0.4 55	-0.6 71	-1.1 96	-0.9 96	-0.9 129	-0.6 98	-0.2 100	0.0 74	-0.4 64	-0.3 34
1907	0.7 15	-1.0 35	-0.2 42	-0.4 71	-0.4 120	-1.1 110	-0.8 95	-1.2 113	-0.9 90	-0.9 84	-0.4 65	-0.3 29
1908	0.9 9	0.8 43	-0.6 57	-0.5 54	-0.7 78	-0.6 73	-0.1 89	-0.6 78	-0.8 64	0.4 52	0.9 58	0.3 24
1909	0.2 7	0.2 35	-0.2 49	0.1 94	0.0 80	0.7 95	0.1 54	-0.4 89	0.2 51	-0.3 89	0.2 29	0.0 40
1910	1.1 7	-0.6 26	-0.3 20	-0.8 53	-0.3 96	0.4 76	0.1 75	0.3 56	0.1 52	0.1 59	-0.6 57	0.1 39
1911	0.5 29	0.1 34	-0.2 62	0.2 67	0.1 80	-0.3 84	0.0 78	0.6 71	-0.1 91	-0.3 58	-0.9 50	-0.2 23
1912	0.4 27	0.1 43	-0.1 52	0.1 70	0.2 56	-0.2 96	-0.3 78	-1.4 72	-0.6 79	0.2 44	-0.4 58	-0.1 22
1913	-0.4 26	0.1 49	0.6 44	0.0 86	-0.5 70	-0.5 68	0.1 74	-1.1 115	-0.1 68	-0.1 105	-0.1 73	0.4 25
1914	-0.6 18	0.6 21	0.6 38	-0.3 69	-0.9 61	-0.9 103	-0.8 68	-0.7 73	-0.3 79	0.4 70	-0.1 28	-0.5 22
1915	0.0 40	0.4 29	-0.3 78	-0.2 88	-0.1 81	0.3 92	0.0 77	0.9 43	0.9 67	0.7 54	0.3 50	-0.5 19
1916	-0.5 19	0.8 24	-1.1 79	-0.4 69	-0.8 96	-0.2 50	-0.1 67	0.5 88	0.1 93	0.7 84	-0.3 45	-0.8 16
1917	0.3 43	0.1 9	-	-	-	-	-	-	-	-	-	-
1918	-	-	-	-	-	-	-	-	-	-	-	-
1919	0.1 22	0.3 27	-0.7 43	0.0 47	-0.1 45	-0.2 33	-0.2 51	-0.2 32	0.5 23	-0.5 57	-0.4 5	-0.1 11
1920	0.1 28	0.3 32	0.1 27	-0.3 26	-	-0.3 20	-0.1 41	0.8 31	-0.7 62	0.7 67	0.6 38	0.1 14
1921	-0.5 6	0.7 11	-0.8 31	-0.1 100	-0.4 31	-0.8 45	-0.2 42	-1.0 74	-0.7 47	-0.3 35	0.3 42	0.9 18
1922	0.4 22	0.0 13	0.2 30	-0.6 52	-0.7 37	-1.1 71	-1.1 49	-1.4 30	-1.4 75	-0.5 47	-0.4 33	0.4 11
1923	0.2 16	0.1 23	0.2 31	-0.2 70	0.4 73	-0.3 53	-0.3 48	-0.9 52	1.6 41	-0.8 53	-0.9 30	0.4 17
1924	0.4 17	0.3 28	-0.1 27	-0.5 36	-0.4 66	-0.2 34	0.1 42	0.1 44	-0.6 62	-0.2 38	0.0 31	0.0 18
1925	0.7 5	-0.7 23	0.2 33	-0.1 42	-0.5 58	-0.6 36	-0.5 63	-0.1 26	-1.1 48	0.3 32	0.0 40	0.9 10
1926	0.5 13	0.8 24	0.0 18	0.5 34	0.3 63	0.1 65	0.9 62	0.3 28	-0.4 59	-0.9 27	-0.3 70	0.4 21
1927	0.1 13	0.4 26	0.4 26	0.4 18	0.2 29	-0.3 23	0.8 32	0.2 32	-0.7 84	0.4 28	0.5 37	-0.4 16
1928	0.6 8	0.1 42	0.1 52	0.2 42	0.0 32	-0.1 37	-0.6 55	-0.2 38	0.0 44	0.5 45	0.2 28	0.2 27
1929	0.6 18	0.6 22	0.8 50	0.4 49	0.3 50	0.0 48	0.0 61	0.1 62	-0.5 70	-0.5 50	-0.7 37	0.1 39
1930	-0.6 21	0.1 59	0.5 50	0.1 74	0.0 56	-0.4 46	-0.3 58	-0.5 58	0.1 54	-0.4 79	-0.5 44	-0.1 36
1931	0.5 17	-0.1 31	-0.4 24	-0.4 61	0.0 38	-0.2 44	0.0 16	0.4 59	0.2 22	0.6 30	1.0 10	1.3 12
1932	-	1.0 10	0.1 12	-0.5 12	0.3 49	1.0 29	0.6 15	-0.2 19	0.3 21	-0.1 26	-0.6 10	0.4 5
1933	0.5 10	0.1 5	0.1 11	0.8 22	0.8 29	0.7 15	1.1 17	0.4 11	1.2 20	0.7 38	0.5 19	1.5 20
1934	0.0 6	0.8 13	0.4 26	0.3 23	-0.3 15	0.8 34	1.2 22	0.4 11	-0.3 26	-0.5 26	0.2 11	0.1 6
1935	1.3 6	0.1 9	0.7 5	0.6 10	2.0 13	0.7 11	-0.2 6	0.1 19	0.4 17	-0.1 9	-0.4 7	-0.2 5
1936	-	0.4 12	0.5 19	0.8 8	0.3 40	-	1.0 29	1.0 6	0.8 20	-	0.4 10	1.4 9
1937	0.5 15	0.3 22	-0.4 18	0.3 35	0.4 29	0.6 41	-0.2 26	-0.2 34	0.4 12	-0.2 13	0.3 33	0.2 26
1938	1.0 8	1.3 1	0.2 50	0.8 7	0.3 35	-0.2 30	-0.1 27	0.4 5	0.2 8	0.7 3	0.3 17	0.2 26
1939	-	-1.0 8	0.0 15	0.3 15	0.3 3	-	-	1.9 4	-	-	0.8 6	-

Table 3. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Area N (see Fig. 1) during the Years 1876–1939.

Area N.	January	February	March	April	May	June	July	August	September	October	November	December
	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n
1876	—	—	—	—	—	—	—	—	—	0.0 4	—	—
1877	—	—	—	—	—	—	—	—	—	—	—	—
1878	—	—	—	—	—	—	—	—	—	—	—	—
1879	—	—	—	—	—	—	—	—	—	—	—	—
1880	—	—	—	0.3 2	—	—	2.4 4	0.8 2	0.5 5	—	0.8 9	—
1881	—	—	—	—	0.9 3	-0.6 9	-0.6 8	-1.0 3	—	-0.6 6	—	—
1882	—	—	—	-0.6 13	-0.3 5	-0.4 14	-0.8 8	-0.8 11	-1.3 1	0.4 1	0.1 3	—
1883	—	—	-0.6 9	-0.1 12	-0.1 9	0.5 11	0.8 17	0.4 4	0.5 6	-0.2 2	—	-1.6 3
1884	—	-0.3 9	-0.6 6	-1.9 9	-1.4 16	-1.1 12	-1.4 7	-1.9 2	-1.1 1	-0.9 4	-0.9 3	-0.8 3
1885	-0.8 7	-1.0 14	-0.9 14	-0.8 13	-0.9 14	-2.0 23	-1.1 6	-1.0 3	0.0 2	-0.4 7	—	1.0 2
1886	—	-0.2 4	0.7 12	-0.2 14	0.2 18	0.4 20	0.3 13	-0.7 8	-0.1 2	0.0 5	-0.4 9	-0.1 9
1887	-0.2 10	0.3 12	0.3 21	1.5 28	0.8 27	1.2 29	0.8 11	1.0 10	-0.8 4	—	0.3 17	-0.6 9
1888	1.2 4	0.8 6	1.2 12	0.8 19	0.7 32	1.6 8	1.8 4	1.5 2	0.1 3	2.9 1	0.5 11	0.7 9
1889	1.9 7	0.9 14	1.6 6	1.4 4	0.9 12	0.1 10	0.1 9	-0.4 9	0.9 1	0.9 3	0.6 4	—
1890	-0.9 2	1.8 4	-0.3 10	1.3 6	0.0 5	0.4 11	0.2 31	0.6 13	-0.6 6	1.6 2	0.7 6	0.6 9
1891	0.8 3	1.4 7	-0.3 15	1.6 22	0.7 21	1.0 17	0.8 24	1.5 7	0.2 6	0.0 19	-0.3 11	1.3 5
1892	—	0.7 8	0.4 17	0.3 17	0.2 22	0.8 34	0.7 23	0.7 9	0.5 7	0.4 4	1.3 12	1.8 4
1893	1.6 8	0.1 6	1.3 11	1.2 24	0.9 23	1.4 6	1.5 9	1.4 4	2.0 4	0.6 8	—	-0.2 14
1894	1.2 8	-0.1 19	0.3 29	0.1 29	0.6 36	0.1 40	-0.7 21	-1.7 4	0.9 6	1.0 4	-0.4 5	-0.2 8
1895	1.0 8	0.9 9	0.3 16	0.9 23	0.0 25	0.5 22	0.5 30	-0.6 9	0.8 5	-0.2 5	0.3 3	-0.3 17
1896	0.8 16	0.6 23	0.3 22	1.1 22	1.8 28	0.0 34	-0.3 19	0.2 6	-0.3 5	-0.5 5	0.7 12	1.2 6
1897	0.7 22	1.1 23	-0.2 28	0.1 56	-0.5 46	0.4 38	-0.7 11	-0.1 7	-0.6 19	1.0 3	2.0 8	0.2 14
1898	2.0 3	1.1 9	0.1 33	-0.7 27	0.1 50	0.7 63	1.3 27	1.2 28	0.2 10	0.4 17	-0.3 12	-0.2 7
1899	0.1 18	-0.5 21	1.4 40	0.3 42	1.2 39	0.9 40	0.1 51	1.0 18	0.2 18	0.5 21	0.2 24	0.5 14
1900	0.9 4	1.6 10	1.8 19	1.1 44	0.7 37	0.7 24	-0.1 24	-0.5 17	-0.5 33	-0.5 38	-0.3 18	0.1 4
1901	0.4 19	0.3 25	0.2 32	-0.6 30	0.1 40	0.1 44	-0.1 39	-0.3 20	-1.1 13	-0.9 13	-0.3 13	0.2 17
1902	0.6 16	0.9 15	0.1 37	0.3 38	1.7 29	1.3 35	1.6 47	2.0 16	0.9 20	1.7 3	0.3 8	0.3 21
1903	-1.0 7	0.4 23	-0.6 49	0.3 30	-0.2 52	0.0 47	-0.3 59	-0.4 28	-1.2 8	-0.4 15	-0.1 19	0.2 8
1904	-1.2 10	-0.7 18	-0.7 41	-0.9 49	-1.0 80	-1.1 55	-1.2 55	-0.3 32	-1.2 13	-1.0 12	-0.3 15	-0.4 13
1905	-0.8 10	-1.0 9	-1.3 27	-0.4 27	-0.1 65	-0.8 24	-1.1 33	-0.9 16	-1.5 3	0.3 10	0.4 6	0.0 28
1906	0.0 10	-0.7 15	-0.9 22	-0.3 24	0.0 47	0.0 39	-0.2 46	-0.4 16	-0.3 23	-0.3 26	-0.5 10	-0.3 14
1907	0.1 10	0.2 16	0.1 25	-0.2 28	-0.7 43	-0.8 52	-0.7 57	-0.4 9	-0.2 22	-0.5 29	-0.9 15	-0.6 4
1908	-0.4 7	-0.4 13	-0.2 23	-0.3 22	-1.0 33	-0.5 28	-0.7 20	0.6 9	-0.5 27	-0.2 5	1.2 5	-0.2 6
1909	0.2 8	0.1 16	0.6 23	0.1 29	0.6 46	1.2 32	0.3 20	0.9 7	0.7 16	-0.2 6	1.6 4	0.0 26
1910	0.0 1	-0.2 4	0.3 16	0.4 18	-0.5 25	0.3 22	0.0 16	0.2 13	0.5 11	0.9 8	1.8 6	0.4 4
1911	1.2 2	0.9 12	0.2 36	0.6 25	0.0 34	0.4 39	0.2 21	0.9 12	0.0 21	0.9 9	-1.1 9	-0.9 4
1912	0.2 7	-0.7 44	-0.1 24	0.3 28	0.1 44	-0.7 54	-0.9 53	-0.2 24	-0.4 14	-0.8 9	0.5 8	-0.7 5
1913	-1.9 13	-1.5 14	-2.3 28	-1.2 47	-1.4 36	-1.6 23	-1.0 23	0.2 3	0.2 9	-0.8 13	-0.7 3	-0.8 5
1914	0.6 4	-2.3 8	-1.4 13	-1.0 29	-1.2 29	-0.3 36	-0.9 29	-0.4 46	-0.9 11	0.8 25	—	-2.0 1
1915	-0.3 6	-1.1 10	-0.1 51	0.1 34	1.4 13	2.0 40	1.2 36	1.2 31	0.9 7	0.2 2	—	0.7 10

(Table 3 continued).

	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1916	1.2	2	-1.8	8	-0.5	31	-1.0	27	-1.0	27	0.3	26	1.7	28	1.5	75	0.9	8	1.5	8	-1.6	15	-0.6	2
1917	-0.3	4	0.6	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1918	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-0.3	1
1919	-0.9	4	0.4	2	-0.6	24	0.3	32	1.0	19	-0.2	17	0.8	21	1.1	18	-0.9	3	1.0	2	1.4	4	-0.3	1
1920	-0.4	5	-0.3	19	-1.0	15	-1.0	16	—	—	-0.7	12	-1.1	30	-1.0	12	-0.8	4	0.1	7	-1.2	6	-1.0	8
1921	—	—	1.2	3	-0.5	18	-1.0	33	-0.9	21	0.3	24	0.4	25	-0.2	21	-0.6	25	-0.3	9	0.5	6	0.0	7
1922	-2.1	1	-1.6	4	-1.0	19	-1.1	7	-0.6	28	-1.0	32	-1.9	30	-1.7	23	-1.8	19	-0.8	19	0.1	14	0.2	7
1923	0.2	12	-1.1	24	-0.4	23	-0.8	25	0.2	29	1.1	31	0.4	20	-0.7	26	-1.1	8	-1.1	14	-1.2	4	-0.3	1
1924	-1.9	6	0.7	10	0.6	13	0.3	18	0.3	9	0.3	12	0.3	11	-0.2	7	-0.9	10	-0.6	3	-0.6	4	0.2	1
1925	—	—	-1.8	5	-0.1	13	-0.3	18	-0.7	24	-0.2	19	-1.1	16	-0.6	3	—	—	1.6	4	1.6	2	—	—
1926	-0.2	3	-0.3	2	-0.3	6	-0.5	15	0.9	25	0.0	25	0.1	16	-0.5	16	-0.5	5	-0.4	2	-1.2	4	—	—
1927	-0.9	3	0.3	1	-1.2	5	-0.5	10	0.2	21	0.4	26	0.7	3	—	—	-0.6	3	—	—	-1.1	16	—	—
1928	-1.0	3	-1.2	7	-0.5	19	-0.3	34	0.8	24	0.5	23	0.1	22	—	—	—	—	—	—	0.4	5	0.2	4
1929	2.0	1	—	—	0.1	16	0.2	30	-0.2	32	-0.6	40	0.1	37	0.1	10	—	—	—	—	—	—	—	—
1930	-1.1	3	-1.0	17	-0.7	24	0.3	23	-0.1	34	-1.0	12	-1.5	5	—	—	—	—	-0.4	2	—	—	—	—
1931	—	—	—	—	—	—	—	—	0.0	2	—	—	-0.7	5	—	—	—	—	—	—	—	—	—	—
1932	—	—	—	—	-0.4	3	0.2	11	0.9	13	1.2	10	—	—	—	—	—	—	—	—	—	—	—	—
1933	—	—	0.4	2	-0.3	6	0.5	9	0.2	8	0.5	8	—	—	—	—	—	—	—	—	—	—	—	—
1934	—	—	1.3	4	0.0	5	0.2	13	-0.6	14	0.3	16	0.4	8	1.1	12	—	—	—	—	—	—	—	—
1935	—	—	—	—	-1.5	3	0.4	8	1.9	10	0.0	10	-0.6	1	—	—	-1.1	2	—	—	—	—	—	—
1936	—	—	—	—	0.6	2	0.4	1	-0.5	10	—	—	-0.6	4	—	—	—	—	—	—	—	—	—	—
1937	—	—	-0.2	4	-0.1	6	0.9	5	0.2	14	—	—	0.1	8	—	—	—	—	—	—	—	—	—	—
1938	—	—	—	—	-0.8	9	0.0	3	-0.2	5	0.5	4	—	—	—	—	—	—	—	—	—	—	0.2	13
1939	—	—	-1.2	1	0.3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 4.
Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Areas L, M, and N (see Fig. 1) for the Period 1945—1949. 1)

	Area L			Area M			Area N		
	1946	1947	1948	1946	1947	1948	1946	1947	1948
	Δ	n	Δ	n	Δ	n	Δ	n	Δ
January.....	—	—	0.7	25	1.0	16	-0.6	6	—
February....	—	—	1.4	24	-0.7	14	0.9	15	—
March.....	2.0	3	0.6	21	1.8	19	0.7	12	—
April.....	1.4	12	1.0	45	-0.1	13	0.1	22	0.3
May.....	2.1	11	0.6	41	0.2	12	-0.1	9	0.8
June.....	0.6	13	0.4	76	0.1	16	1.0	22	0.8
July.....	-0.1	16	0.4	26	0.2	29	0.5	26	0.1
August.....	0.3	28	1.0	19	-0.5	28	-0.1	17	-0.2
September..	0.8	25	-0.1	16	-0.5	26	1.0	33	-0.3
October.....	0.7	48	0.7	26	-0.4	15	0.7	16	0.6
November ..	1.6	15	0.8	29	0.4	17	0.3	23	1.6
December ..	0.9	18	1.5	15	0.7	18	0.0	22	2.0

1) For 1945 the only anomalies available are: Area L, December, $\Delta = 1.4$, (n = 3); Area M, November, $\Delta = 1.1$, (n = 4).

Hydrographic Conditions in the Waters North of Iceland, July and August 1949.

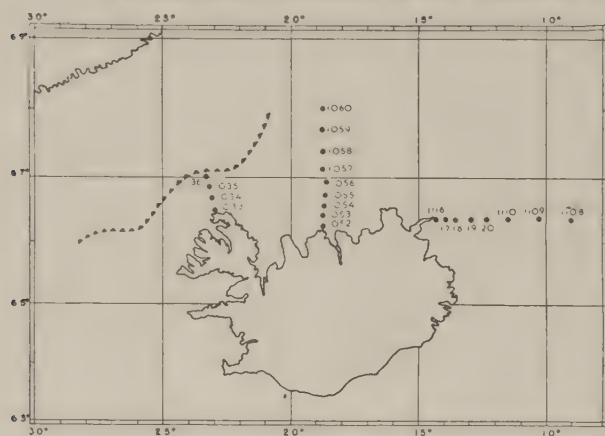


Figure 5 a.



Figure 5 b.

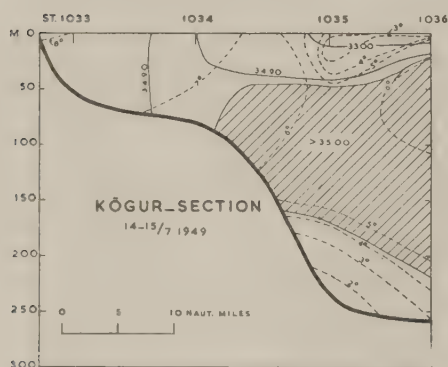


Figure 6 a.

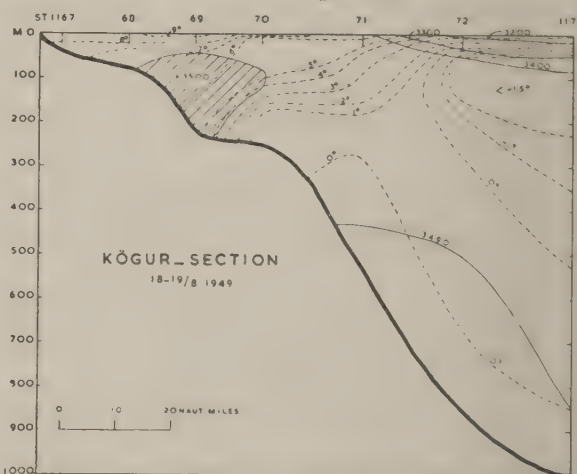


Figure 6 b.

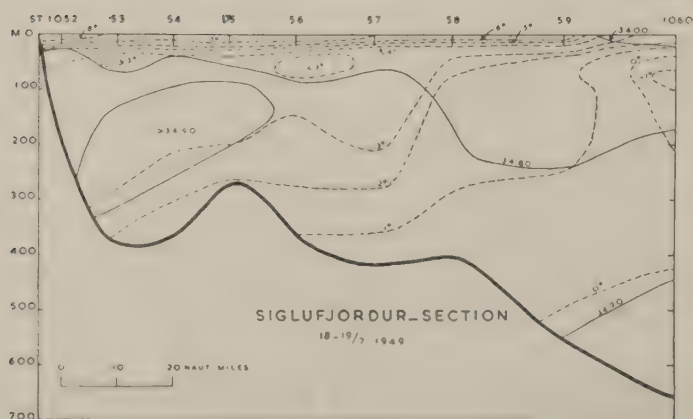


Figure 7 a.

From July 14th to August 5th and August 18th to 29th, two hydrographic cruises were made in the waters around Iceland and between Iceland and Jan Mayen. Only a few of the sections examined will be discussed in this report. The location of the stations discussed is shown in Figures 5a-b. The ice limit as it was on the first cruise is shown in Fig. 5a. On the second cruise no drift-ice was observed so the ice limit was displaced a considerable distance towards NW. during the period of nearly one month between observations.

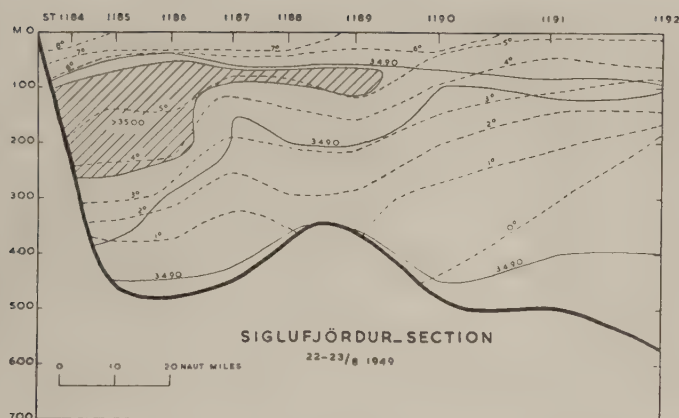


Figure 7 b.

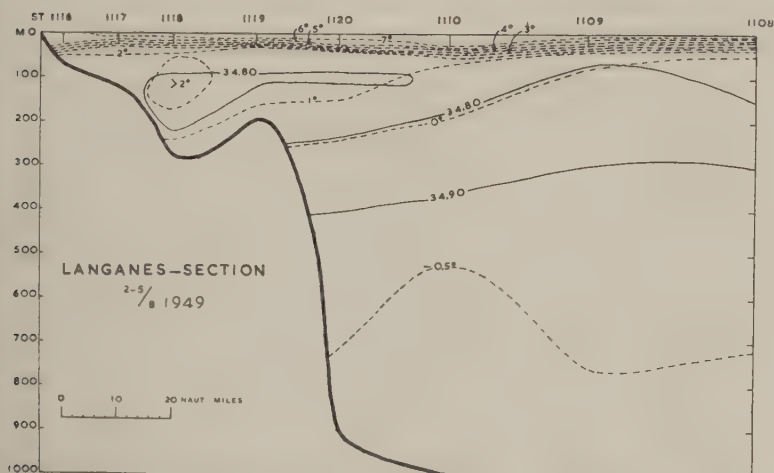


Figure 8 a.

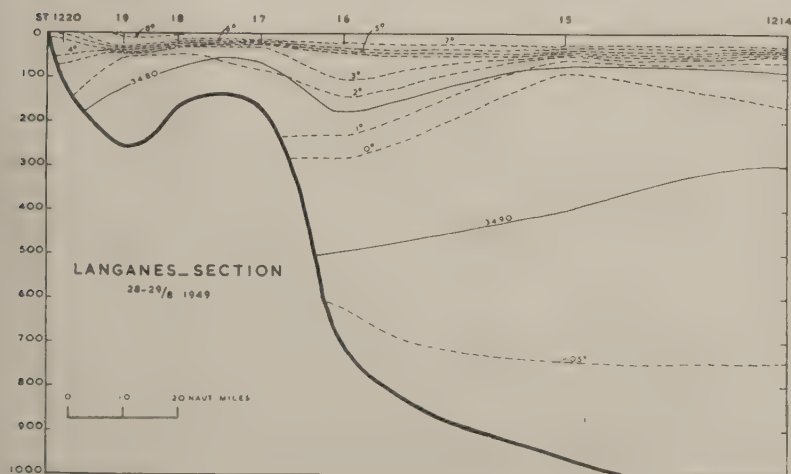


Figure 8 b.

Figures 6a–8a show the hydrographic situation during the second half of July and the beginning of August. In the Kögur section, Atlantic water appears as an intermediate layer between about 50 and 200 metres. It does not, however, reach all the way down to the bottom as usually observed. The temperature is considerably lower than normal and between stations 1035 and 1036 the surface temperature decreases to less than 3°C . near the ice limit. The Siglufjörður section extended to Lat. $68^{\circ}00' \text{N}$., is characterized by low temperature and low salinity. The tongue of water with salinity between 34.9 and $35.0^{\circ}/_{00}$ at the first stations, is undoubtedly due to the influence of Atlantic water, the influx of which, however, must have been exceptionally weak at this time. In the Langanes section a very marked thermocline is seen at about 25 metres depth. The underlying water is abnormally cold.

Figures 6b–8b show the situation during the second half of August. In the Kögur section extended to Lat. $68^{\circ}00' \text{N}$., Atlantic water appears as a tongue between stations 1168 and 1170. The temperature at the first stations is about 1°C . higher than it was in July. In the northernmost part of the section the character of the typical East Greenland Polar Current is seen. The course of the isotherms and isohalines indicates an east-going current between the first 5 stations (1167–1171) and a west-going current between the last 3 stations (1171–1173). The boundary of the East Greenland Polar Current therefore, lies in the neighbourhood of station 1171. In the Siglufjörður section Atlantic water is observed as an intermediate layer between about 75 and 250 metres at the first 3 stations. The temperature at the intermediate depths has increased considerably since July. The influx of Atlantic water was therefore stronger in August than it was in July as was also the case in 1947 and 1948. In the Langanes section the condition is very similar to that at the beginning of August except for a slight increase in temperature in the uppermost layers.

UNNSTEINN STEFÁNSSON.

Thermographic Records of the Sea-Surface Temperature along the Icelandic Coast.

In the early spring of 1949 self-registering thermographs of the type supplied by Negretti & Zambra, London, were installed on board two coastal liners, the M/S "Esja" and the M/S

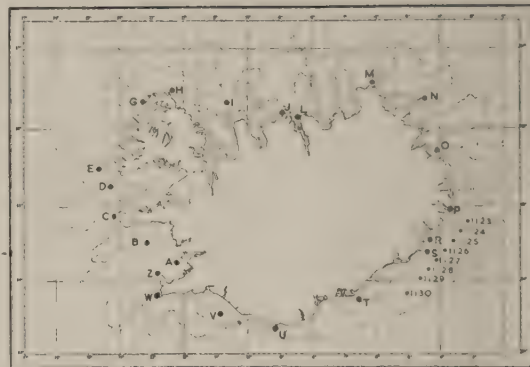


Fig. 9. Location of Stations.

"Hekla". Each month there were about 3–4 trips around the island. During the summer months "Hekla" was running from Reykjavik to Glasgow. Furthermore, a sea-thermograph was installed in M/S "Tröllafoss" running across the Atlantic Ocean from Reykjavik to New York.

The following report is based on the temperatures at 21 different places along the coast. The data are taken from the thermograms obtained from the coastal liners. The positions of the places selected, shown on Figure 9, are marked with capital letters.

Figures 10, 11, 12, and 13 illustrate the temperature for each of these 21 localities from March to December 1949.

At the west coast (Figure 10) the curves show that the maximum temperature is found in late July and the minimum in March and April. The relatively high values found on the south-west coast during the early spring, particularly at position B, situated fairly off-shore in Faxaflói, are undoubtedly due to the presence of Atlantic water. On both the north and east coast (Figures 11 and 12) the temperature during the spring months is very low, from 0° to 2°C . The abrupt change in the sea-surface temperature in June, especially off the north coast can be explained by the fact that the spring was abnormally cold throughout the country, more arctic pack ice moved in to the northern coasts of Iceland than has been seen there for years, and a general warming-up first took place in June. The change of temperature is greatest at positions M and N (Figs. 11 and 12). Thus at position M it is more than 10°C . This agrees well with the fact that off the north-east coast the stability of the water is greatest.

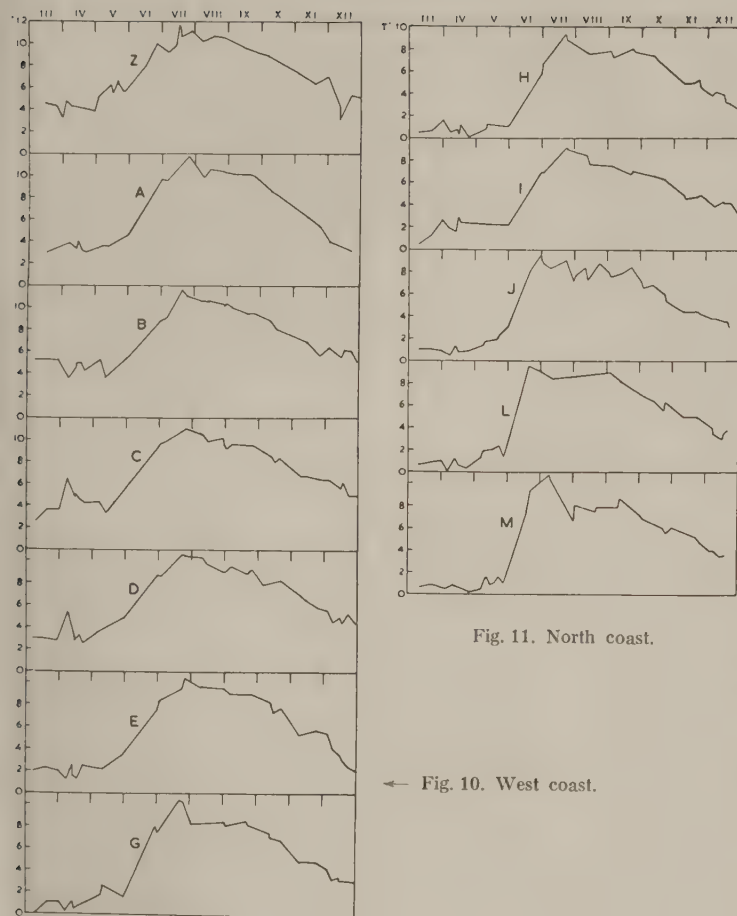


Fig. 11. North coast.

← Fig. 10. West coast.

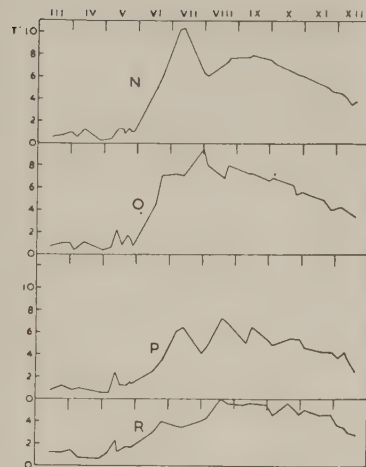
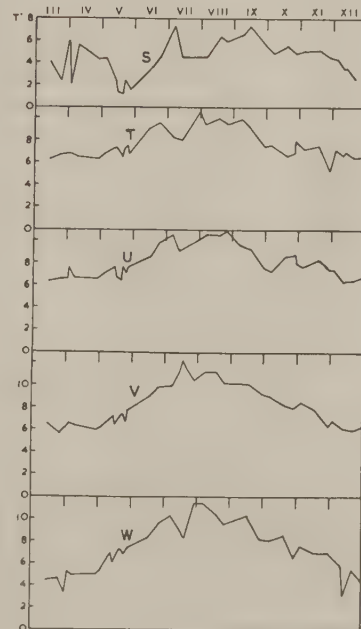


Fig. 12. East coast.

Fig. 13.
South coast.Fig. 10—13. Temperatures at fixed places
along the Icelandic coasts plotted from the
sea thermograms from March to
December 1949.

The strikingly low surface temperatures during the summer months at position R (Figure 12) can be ascribed to vertical convection currents formed in this locality where the cold water of the East Icelandic Current meets the warm Atlantic water. That such vertical convection currents exist near this place is clearly seen on Figure 14 showing a section running from north to south across the current boundaries. The positions of the stations in this section are shown on Figure 9. In this section, worked in the beginning of August, the isotherms and isohalines run almost vertically near the boundaries, and the water is not very stable. The fertility of the waters in this mixing-area should therefore be great. Off the south-east coast fog is very frequent during the summer months, a

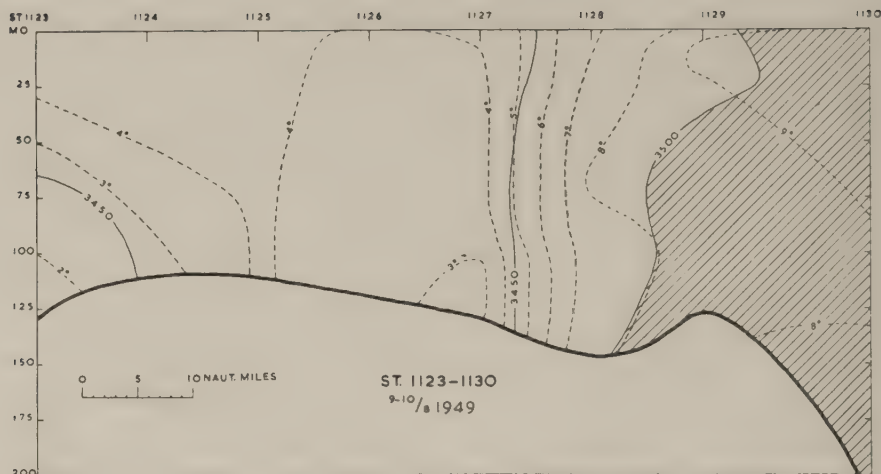


Figure 14.

fact which might be attributed to the low surface temperature during these months. At position S, situated off Eystrahorn (Figure 13), great irregularities are found in the temperature. Wind conditions might be responsible for some of these temperature changes, but it is more likely that they are caused by displacement of the warm water front. Off the south coast (positions T–W) the change is small, at position U it is less than 5° C.

Figure 15 shows the monthly mean surface temperature along the coast. During March, April and May the temperature difference between the south and the north coast is great. At positions R and S the rise in temperature is

very abrupt in the early spring, becoming smaller during the summer, and in October the temperature is uniform all round the coast.

UNNSTEINN STEFÁNSSON.

Greenland

Hydrographic Observations during the Cruise of M/S »Vardholm« during 2nd July–23rd August 1949.

In 1949 a cruise was undertaken to Icelandic and Greenland waters with the chartered Norwegian fishing vessel “Vardholm”. The hydrographic sections and other stations

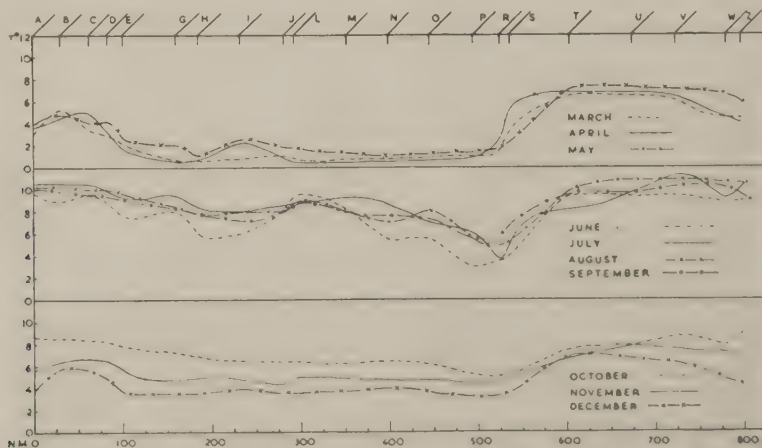


Fig. 15. The monthly means of the sea temperature March–December 1949.

worked in the area are shown in the accompanying chart (Fig. 16). The hydrographic sections are not as yet fully worked out for publication, but a short note of the most pronounced features will be given here.

In the Iceland area hydrographic sections were worked in the following localities: between Jan Mayen and Langesnes on 2.—4. July, from Rifstangi and 50 miles northwards on 4. July, and from Kolbeinsey towards Siglufjörður (60 miles) on 5. July.

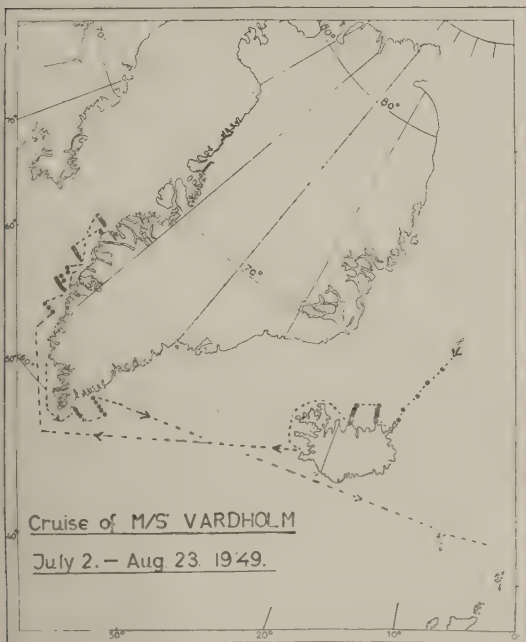


Figure 16.

The most striking feature of the hydrographic observations was the presence of large masses of cold arctic water. Thus in a position 70 miles south of Jan Mayen water with temperature below 0°C . was found below 50 metres depth. On a station 60 miles north of Langesnes the cold water was found from 75 metres and downwards. On the shelf off Langesnes temperatures between 0 and 1°C . were found below 50 metres. On a station 60 miles north of Rifstangi cold water with a temperature below 0°C . was again found in depths between 50 and 250 metres. On a station taken off Kolbeinsey no cold water was present.

As regards the temperature conditions off West Greenland the following notes have been made:

A section was worked across Danas Bank on 21. July. In the central portion of the bank the temperature was 2.60°C . at the surface decreasing to 0.17°C . at the bottom (75 m.). A layer of comparatively cold water was found along the western slope of the bank, the temperature here decreasing from 0.77° at 10 m. to 0.13°C . at 75 m. Below 100 m. the temperature again increased.

The section across Fyllas Bank was worked on 26. July. On the middle of the bank the temperature was 4.95°C . at the surface decreasing to 1.68°C . at the bottom. Along the western slope of the bank a core of colder water was lying between 100 and 200 m. depth, the minimum temperature here being 0.28°C .

A section of 7 stations worked across Lille Hellefiske Bank on 28. July showed similar features. On the most shallow part of the bank (56 m.) the temperature was 8.30°C . at the surface decreasing to 1.18°C . at the bottom. A core of colder water was lying along the bottom of the western slope. In depths between 75 and 150 m. the temperature here was less than 1°C ., the lowest temperature (0.15°C .) being measured at the bottom at a depth of 90 m. Below 150 m. the temperature again increased.

A section across Store Hellefiske Bank on 30. July showed that the whole shallow portion of the bank was covered with temperate water with a temperature somewhat above 2°C . In depths below 100 m. on the western slope the bottom water had temperatures below 1°C .

BIRGER RASMUSSEN.

Hydrographic Investigations near Disko (Greenland) in the Summer of 1949.

As there were indications in the summer of 1948 that a break in the warm period in the West-Greenland waters was setting in, and as the winter of 1948—49 had been unusually hard and long, it was considered desirable that the hydrographical researches of 1948 should be continued on the same lines in 1949. However, as I could not personally carry out the task, as I did in the previous year, I accepted with thanks the kind offer of Vice-Admiral A. H. VEDEL of the Royal Danish Navy to allow the inspection vessel "Hejmdal" to repeat the most important of the sections I had operated with the M/C "Steenstrup" round Disko as far as this was compatible with other work of the Danish Naval vessel at Greenland. Captain GROTH, succeeded in operating the

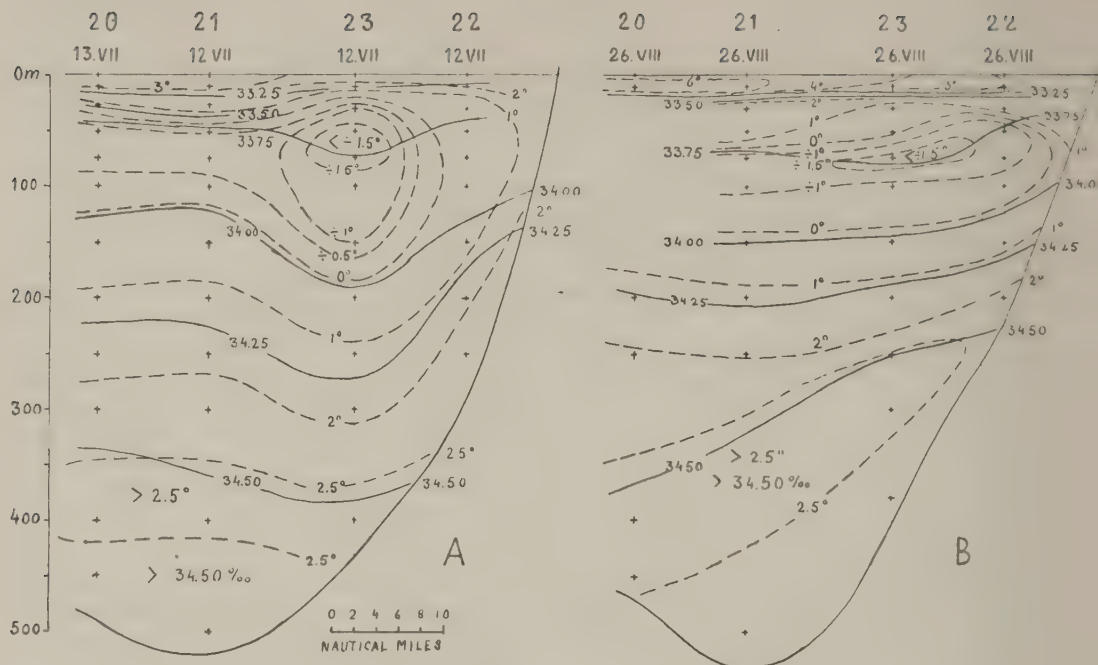


Fig. 17. Section I. From Hare Island towards the WNW. (see Ann. Biol., V, p. 25).

fixed stations fully. The collected material has been titrated and corrected at the Hydrographic Laboratory and will appear in the *Bulletin Hydrographique* 1949.

The warm under-current in 1948 had been

somewhat colder south of Disko than north of Disko, which meant, as previously reported (Ann. Biol. for 1948), that the warm water in the northern area was brought by a current which had passed through the Davis Strait in

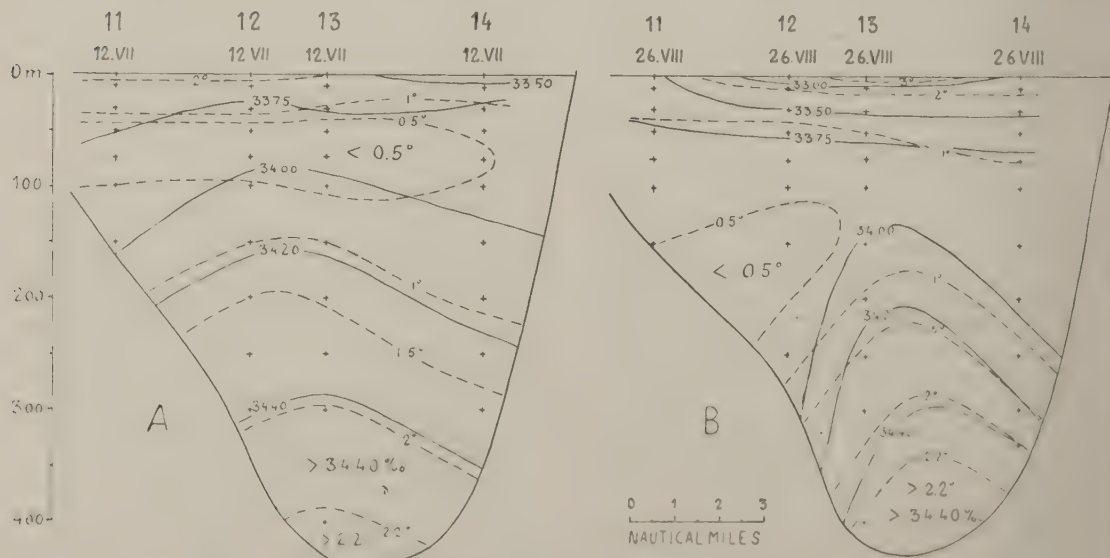


Fig. 18. Section II. Across the northern entrance to the Vaigat from Hare Island to Nugssuaq.

Notes on the Ice Conditions in Greenland Waters in 1949.

The ice conditions along the east and west coasts of Greenland were rather unusual during the summer of 1949.

On the cruise of M/S "Vardholm" various observations were made with regard to the drift-ice. Observations on the ice conditions were also collected from various other sources in order to get an idea of the general situation.

During the first days of July "Vardholm" followed a course from Jan Mayen towards Iceland. At a distance 70–120 miles NNE. of Langanes, Iceland, we observed a certain milkiness of the sea and simultaneously a drop in the air temperature. The surface temperature in the sea was nearly 5° C., but below 75 m. only negative temperatures were found. The general conditions indicated that the ice-pack was not far away, but there was a heavy fog and the ice field was not actually observed.

In the middle of July Norwegian sealers lying in the Denmark Strait reported that the ice was lying about 100 miles offshore and that the pack was unusually heavy. At the same time herring fishermen off North Iceland reported being disturbed by the ice. According to actual observations the border of the ice-pack was lying 60 miles north of Cape Kögur, Iceland. Further south, off Cape Farewell, the ice belt on July 15–16 stretched 60–80 miles from the shore with offshoots or tongues going still further out.

In the Davis Strait proper the ice was lying off the Julianehåb District at a distance of 50–60 miles from land. The drift-ice was found as a more or less compact mass as far north as Danas Bank, and strips of ice could still be seen some distance further north. Close to the coast south of Danas Bank there was an open lane of water stretching towards Cape Desolation north of Julianehåb. The ice-pack all along the coast was unusually thick and heavy.

In ordinary years the drift-ice disappears from the coast of West Greenland in the course of July, and in August–September the East Greenland coast is also nearly free from pack-ice. (Icebergs, which originate from calving glaciers, are not taken into consideration here). During the summer of 1949, however, the drift-ice did not disappear at all. About the middle of August the ice-pack was still blockading the Julianehåb Bay, and the ice border was lying

40 miles off Cape Desolation in the northern part of the bay. A Norwegian oil tanker was blocked in the Julianehåb District for three weeks in July–August before being able to force its way out to open water.

On 16. August the ice-pack off Cape Farewell had a width of 30–40 miles. Northwards along the coast of south-east Greenland the ice-pack was lying as a belt 30–35 miles wide. However, the ice had an undulating border and there were some wide openings in the ice belt where it was possible to sail quite near the coast.

As regards north-east Greenland it was also unusually difficult to contact the coast here, even for ships built specially for the task. As late as 15. September Danish and Norwegian vessels which were lying at Clavering Island on 74 N. Lat. had severe difficulties in getting out of the ice belt which stretched about 70 miles from the shore. Also they reported that the ice was unusually heavy and difficult to force through.

Several factors of a meteorologic and hydrographic nature acting together might have been the cause of the unusual ice conditions in Greenland waters during the summer of 1949. I shall point only to a single phenomenon which has possibly had some influence on the situation.

Our hydrographic observations in June 1949 proved that large volumes of comparatively warm Atlantic water had penetrated into the Barents Sea and into the Polar basin north of Spitsbergen. No ice-pack was visible as far north as 80° N. Lat. on 15. June, and Norwegian whalers reported that they had been as far north as 81° N. Lat. without sighting the ice, a situation which is rather unusual at such an early date as the middle of June. It is possible that the warm Atlantic water during spring and summer has penetrated unusually far towards the north, and that this warm water has broken up the ice over a larger area than usual, with a subsequent increased flow of ice along the Greenland coast. The fact that the drift-ice this year was unusually thick and heavy indicates that it was not only ice frozen in one winter which had broken up, but that areas which had not been touched by the summer break-up in 1948 had broken up in 1949.

BIRGER RASMUSSEN.

Plankton.

Faroe.

The plankton in the neighbourhood of Faroe was sampled by Scottish research vessels in 1949, in March, May, July, September and November. A general account of the investigations correlated with the results from other areas is given in the Northern North Sea Area Report. Of particular interest in the Faroe region was the contrast between the plankton there and that entering the Faroe Channel near the Scottish coast. Faroe plankton was richer in Calanus and Crustacea generally and contained also Laodicea, Staurophora and Clione,

which were absent or very scarce in Scottish regions. It is suggested that there is evidence of two streams of oceanic water of different origin; one an open Atlantic stream principally affecting Faroe but eventually giving off a branch into the North Sea round the north of Shetland; the other coming from the Azores area and directly affecting Scottish waters. Each stream followed a different path through the Faroe Channel. Aurelia and Cyanea were even more abundant at Faroe in the late summer than usual.

J. H. FRASER.

THE FISH.

Halibut.

Statistics for North-West Grounds 1936-47.

In the Scottish statistics of halibut landed at Aberdeen by British vessels, four grounds are distinguished in the north-western area,—Greenland, Iceland, Faroe and Western Grounds.

Calculation of the catch per 100 hours fishing by trawlers, and the catch per 100 lines by liners, from each ground as a whole, gives some indication of the fluctuations in density of the stock over a period of years. JESPERSEN 1938 has published these data up to the year 1936, and we are therefore concerned with 1936-47 (see Figure 21 and Table 5).

Greenland.

Few Aberdeen trawlers work in Greenland waters, but several line vessels fished in the East Greenland area in 1936-39 and again in 1946-47. The catch per 100 lines in this area was always considerably higher than that on any of the other grounds in corresponding years. This suggests either a greater numerical density of the Greenland stock or a greater weight per individual fish. When fishing was resumed in 1946, after the wartime respite, there was a considerable increase in the catch per 100 lines, as was also observed on the other fishing grounds (see below).

Iceland.

Fishing at Iceland by Aberdeen liners and trawlers was continued throughout the war

The Area generally

years without interruption. In 1940 the catch per 100 hours fishing by trawlers rose to a high level which was maintained for three years. Thereafter the value fell to the pre-war level, although another increase took place in 1946, but was not maintained.

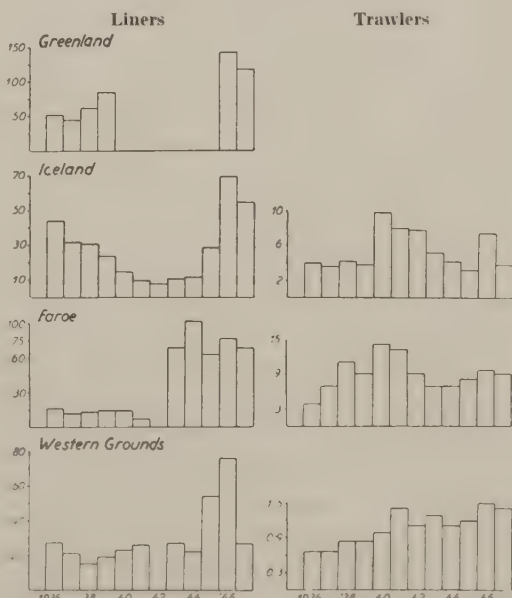


Fig. 21. Catch per 100 hours (trawlers) and per 100 lines (liners) in cwt. from grounds in North-Western Area, British Vessels (Aberdeen) 1936-47.

In the line fishery, the catch per 100 lines showed a steady fall from 1937, a minimum being attained in 1942. The following years, however, showed an increase which reached a peak in 1946 at a figure almost twice the highest pre-war value.

Faroe.

Except for a break in liner landings in 1942, the Aberdeen fishery at Faroe has been heavy, and more halibut have been landed from this area than from any other.

The catch per 100 hours (trawlers) showed irregular fluctuations, but a maximum was reached in 1940–41, and another secondary peak appeared in 1946. The catch per 100 lines fluctuated only slightly from 1937–41, the annual mean being 12.7 cwts. There was no fishing in 1942, but when it was resumed the catch per 100 lines showed a marked increase, reaching a maximum of 92 cwts. in 1944. Although it fell in the years following, the catch still remained considerably higher than the pre-war figures.

Western Grounds.

Under this heading are placed grounds off the north-west and west coasts of Scotland, including Rockall. The catch per 100 hours (trawlers) was fairly steady up to 1940, but an increase took place in 1941. Thereafter the level was maintained a little above that of pre-war, with a maximum occurring in 1946. The liners catches showed irregular variations, but a marked increase took place in 1945, and a peak was reached in the following year.

Conclusions.

A study of the fluctuations in catch per unit of effort recorded above indicates the years which produced the best broods of halibut. The following suggestions can, however, only be verified by data on the age composition of the stocks.

Since trawlers catch smaller and younger fish than liners, a good recruitment year should result in larger catches by trawlers within about three years, although the liner catches would probably not be affected until five or six years later.

Comparison of the figures shows that the increase in trawler catches at Faroe, which reached a peak in 1940, was followed by increased liner catches from 1943 onwards (there was no fishing in 1942). Similar increases took

Table 5. British Vessels Landing at Aberdeen.

Catch of Halibut per hours (trawlers) and per 100 lines (liners) in cwt. from fishing grounds in NW. Area 1936–47.

Year/Vessel	Green- land	Iceland		Faroe		Western Grounds	
	L.	Tr.	L.	Tr.	L.	Tr.	L.
1936.....	52	3.9	44	4	16	0.8	27
1937.....	44	3.6	32	7	11	0.8	21
1938.....	61	4.2	31	11	13	0.9	15
1939.....	85	3.7	24	9	14	0.9	19
1940.....	—	9.8	15	14	14	1.0	23
1941.....	—	7.9	10	13	8	1.4	26
1942.....	—	7.7	8	9	—	1.1	—
1943.....	—	5.2	11	7	70	1.3	27
1944.....	—	4.1	12	7	92	1.1	22
1945.....	—	3.2	29	8	66	1.2	54
1946.....	143	7.3	70	10	76	1.5	76
1947.....	117	3.8	54	9	70.7	1.4	27

L. = liners, Tr. = trawlers.

place at Iceland and on Western Grounds, although in the latter area they were not so well marked. We may deduce, then, that a good brood year for halibut occurred about 1937 resulting in increased trawl catches of three to five-year-old fish in 1940–42. In 1943, at six years old, the year-class would begin to enter the line fishery, accounting for the high figures for catch per unit of effort from then onwards. Since no trawling was carried on at Greenland similar deductions cannot be made for this area, but an increase in the magnitude of the stock is indicated here also by the greater catch per 100 lines when fishing was resumed in 1946.

It may be argued that these high figures were due to the war-time reduction in fishing. If this were so, the catch per unit of effort would remain high during the war years. In fact, however, the trawler peak occurs in 1940, and the figures fall steadily after that year. The suggestion that 1937 may have been a good brood year is supported by JESPERSEN's figures (1948) on the remarkable increase of young halibut (mostly group II) in Faxe Bay in 1939.

Using similar reasoning the increase in trawl catches in 1946 suggests a good brood year about 1943. Confirmation of this will be sought in otolith material at present being collected.

A. D. McINTYRE.

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- JESPERSEN, P. (1938) «Statistical Survey of the Halibut Fishery in the Waters Round Faroes, Iceland and Greenland». Medd. Komm. Danmarks Fiskeri- og Havundersøgelser. Bd. X., Nr. 5.
— (1948) "The Halibut in Faxe Bay". Rapp. et Proc.-Verb., Vol. CXX., Paper No. 8.

Eggs and Larvae.

Fish Eggs and Larvae in Faroese Waters.

In 1949 Scottish vessels visited the Faroe region in March, May and July. Unfortunately the extent of sampling with 1 metre tow-nets (stramin) varied considerably between cruises, but the results provide useful data on the distribution of spring-spawned fish larvae in these waters to serve as a background for the more intensive surveys which it is hoped to carry out in this area in future years.

Haddock.

Sampling during the March cruise was restricted to five stations, all in the northern half of the grounds. Haddock eggs occurred at all of these but only in appreciable numbers at one station north of Enniberg. All the eggs were in early cleavage stages and no larvae were taken during this cruise. When the area was revisited in May, sampling was more general. Haddock eggs occurred at all stations with the greatest concentrations north of Enniberg and south and west of Suderö. Larvae were also taken at all stations except those immediately north of the islands. They were most abundant south of Suderö which was the only station at which larvae of less than 6 mm. were represented. When the area was revisited in July, haddock post-larvae were captured at all stations within the 200 metre contour. Practically all of these were more than 25 mm. in length.

Saithe larvae were already present at all stations in March, though only in numbers of less than ten fish per station. In May they again occurred at all stations, in similar numbers, except for one concentration of more than 50 fish south of Suderö. In July they were only taken at one station NW. of Suderö.

No Cod larvae occurred at Faroe in March. By May they were present all round the islands with the greatest concentration south of Suderö. In July they were still present in small numbers in the northern half of the area.

Whiting larvae did not occur in the collections until the May cruise and then only south and west of Suderö. In July they were taken all round the islands with the greatest numbers north of Enniberg.

Larval Lemon Soles were first taken in Faroe waters during the May cruise, but only

in very small numbers, at two stations south and west of Suderö. In July they occurred to the north, east and south of the islands but were notably absent from the western side. Numbers were small except on the eastern side of the islands where up to 50 larvae occurred at one station. By September, lemon sole larvae were represented only at one station north of Enniberg.

Herring larvae were taken at Faroe in May at two stations south and east of Suderö. They ranged in size from 9–22 mm. with a mode in the 11–15 mm. group.

A. SAVILLE.

Lemon Sole.

During 1949 samples of scales and measurements were taken from 36 trawler catches landed at Aberdeen from Faroese grounds. A total of 3938 lemon soles were thus treated, the size and age analysis of which are summarised in Tables 6 and 7.

Table 6.
Size composition of lemon sole samples from Faroe 1949.

	< 26 cm.	26—30	31—35	36—40	41—45	46—50
No.	342	1268	1577	634	109	8
%	8.7	32.2	40.0	16.1	2.8	0.2

Table 7.
Age composition of lemon sole samples from Faroe 1949.

Brood.	No. of fish.	Catch per 100 hrs. fishing.	%	Brood.	No. of fish.	Catch per 100 hrs. fishing.	%
1947	2	1	+	1938	64	52	2.0
1946	906	463	17.6	1937	157	119	4.5
1945	120	86	3.3	1936	44	28	1.1
1944	364	285	10.9	1935	20	17	0.6
1943	1132	784	29.9	1934	14	13	0.5
1942	191	124	4.7	1933	3	1	+
1941	484	306	11.7	1932	2	3	0.1
1940	106	82	3.2	Total	3933	2624	
1939	324	260	9.9				

In comparison with corresponding figures for 1948 and previous years, Table 6 shows a continued fall in the average size of lemon soles caught at Faroe by commercial vessels since the end of the war. The explanation of this is found in the age analysis (Table 7)

which reveals that nearly half of the lemon soles taken in 1949 belonged to the 1943 and 1946 broods, so that the average age of the fish is less than in previous years. Examination of the catch of each brood per 100 hours' fishing (3rd column Table 7) is more encouraging, however. This shows that the overall catch of lemon soles at Faroe was greater in 1949 than in the two preceding years and indeed almost equalled the best of the post-war years, 1946.

Sixteen different broods were represented in the 1949 catch. The numbers of the older broods were surprisingly well maintained and remarkable increases occurred in some of the younger broods (compare tables in Ann. Biol. for 1948). As in previous years the 1937, 1939 and 1941 broods were predominant among the older broods, while the 1943 brood, as in 1948, proved to be the most numerous brood. As already indicated the 1946 brood was found to be next in importance numerically. This brood was scarcely represented in the catches up to mid-June but about this time two catches were sampled in which it provided 68% and 75% of the catch. Thereafter, although the proportions were not maintained throughout the year at this high level, the brood continued to be caught in large numbers. The main centre of concentration appeared to be in the Mygnaes-Myling Head area but, later in the year, concentrations were also located off Fuglø and Nolsø. The indications are clear that very good recruitment took place to the lemon sole stocks at Faroe in 1946. It would also appear that the growth of this brood was exceptionally good but this feature has not been fully examined as yet.

The improvement in the catch per unit of fishing time is also promising and, provided the intensity of fishing does not increase to any great extent, the stocks of lemon soles should be maintained in the course of the next few years.

Eight samples of lemon soles were also obtained from catches made at Iceland but so far this material has not been examined.

BENNET B. RAE.

Iceland

Cod.

The 1934—1935 and 1936 year-classes have dominated in the commercial catches during the last 5 years. But in the second half of the winter season 1949 the 1942 year-class ap-

peared on the spawning grounds and that year it amounted to 12%. This year-class, 7 years old, mainly consisted of fish spawning for the first time (73.5%) and the second time (24.3%).

The percentage of first-time spawners in 1949 was very low, 17.8, and before the appearance of the 1942 year-class only 10.3. For comparison it can be mentioned that the average of the first-time spawners in the period 1931—38 was 33.1%, varying from 23.7% to 48.6%. In the age-distribution of the first-time spawners the 1942 year-class dominated being 49.3%.

Age	%	Age	%
4	0.1	14	10.4
5	1.2	15	6.7
6	1.7	16	2.5
7	11.9	17	1.3
8	7.6	18	0.6
9	6.9	19	0.2
10	7.5	20	0.2
11	7.9	21	—
12	10.7	22	0.04
13	22.6		

The table shows the age-distribution for 1949. The 1936 year-class shows a definite predominance. About 55% of the fish are 12 years old and older. There is not much to be expected from the 1940—1937 year-classes, but the 1942 year-class is promising.

JÓN JÓNSSON.

Greenland

Observations on Cod during the cruise of M/S »Vardholm« in 1949.

It is generally recognized that the temperature conditions in the sea off West Greenland have great influence on the fishing carried out on the bank. In 1949 commercial fishing with long-lines was carried out by several nations and among these were Norwegian vessels. These latter have reported that the fishing along the western slopes of the banks was satisfactory from early June to the middle of July, while towards the end of July the conditions changed and the cod became scarce along the slope. While working our hydrographic sections it was found that the slopes were covered by cold water masses at that time. It was natural to assume that the fish had left the cold surroundings and had sought deeper or shallower water where the surroundings were more satisfactory. Our fishing experiments in this period proved that the fish, to a large extent, seemed to prefer the shallow portion of the banks if the temperature there was

suitable. According to our observations the cod were not present in any large numbers on the bank or on the slope if the bottom temperatures were less than 1°C .

Age and Size Composition.

In the summer of 1949 samples of cod otoliths and length measurements were collected from the various banks off West Greenland. The fish were caught in the course of ordinary fishing with long-lines. The length of the fish caught varied between 45 and 135 cm. The mean size of the cod taken on all the banks was 74.67 cm. However, the size of the fish varied from one locality to another. The total size distribution of the cod is shown at the bottom of Figure 22. The same figure also illustrates the size of fish on the various banks.

The sizes of cod on each bank are shown here as deviations from the mean for the whole area. The figure clearly demonstrates that the catches on the northern banks contain a high proportion of large fish, while on the southern banks the smaller fish predominate. This also corresponds with the general impression gained during the actual fishing operations. The mean sizes of the fish on the various banks were as follows:

Danas Bank	67.15 cm.
Fiskenes Bank	69.12 —
Fyllas Bank	72.25 —
Bananbank	73.66 —
Lille Hellefiske Bank	76.65 —
Store Hellefiske Bank	75.06 —

This difference in the fish population on the various banks is not only expressed by the size of the fish but also by the age composition. The ages of the cod from the various banks in 1949 are as follows:

Age-group	Danas Bank %	Fiske-næs Bank %	Fyllas Bank %	Banan Bank %	Lille Hellefiske Bank %	Store Hellefiske Bank %
4	12.1	3.2	0.3	—	—	0.2
5	9.9	5.0	—	—	—	1.4
6	24.2	11.1	1.5	5.3	0.3	4.1
1942						
7	26.4	53.2	38.9	28.4	8.4	17.9
8	3.3	5.3	6.7	12.3	2.5	6.1
9	1.1	2.6	4.6	7.0	2.7	5.9
1939						
10	2.2	2.6	4.3	5.7	7.5	11.1
11	1.1	0.9	1.5	0.3	2.2	1.7
12	—	—	1.2	0.7	3.1	3.4
1936						
13	4.4	5.0	11.9	9.3	22.8	19.9
14	5.5	2.0	9.4	7.0	14.7	7.3
1934						
15	7.7	8.5	15.5	20.7	30.8	17.1
16	2.2	—	1.8	1.7	2.5	2.1
17	—	0.6	1.8	0.7	1.6	0.9
18	—	—	0.6	0.7	0.6	0.3
19	—	—	—	—	—	—
20	—	—	—	—	—	0.3
21	—	—	—	—	0.3	—
22	—	—	—	0.3	—	—
23	—	—	—	—	—	—
24	—	—	—	—	—	0.2

On the southern banks it is the young fish which predominate, particularly the 1942 and 1943 groups. On the northern banks the older fish are more strongly represented and here it is the broods from 1934 and 1936 which are particularly conspicuous, intermixed with the 1942 group. According to PAUL M. HANSEN (Ann. Biol. 1948) these three year-classes have

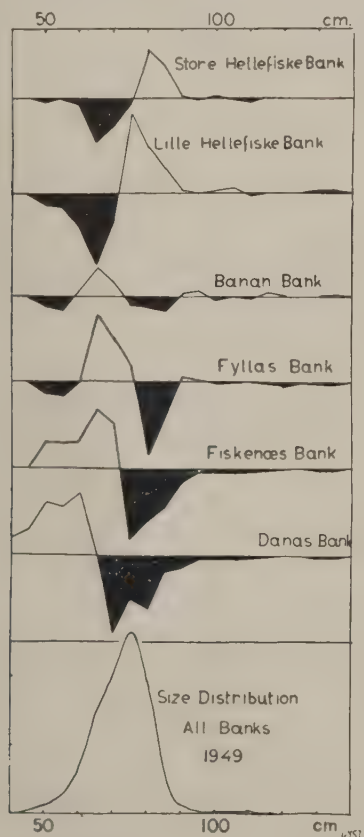


Fig. 22. Size distribution of cod on the West Greenland Banks (bottom), and the distribution on each bank shown as deviations from the mean in each 5-cm. group.

in past years been predominant in the catches in the fjords all along the coast, both in the northern districts and the southern districts. On the banks in the open sea segregation in the cod population seems to have taken place—at least in 1949—in such a way that the larger and older fish have had a tendency to gather on the northern banks while the younger groups to a great extent have stayed on the southern banks. Whether this is an annual occurrence or just a special feature for the summer of 1949 will, I hope, be disclosed by future investigations.

Marking Experiments.

In 1948 some 388 cod were marked on the banks off West Greenland, 344 of which were tagged on Lille Hellefiske Bank on 30.—31. July and 44 on Store Hellefiske Bank on 8. August. The type of tag used was a yellow plastic disc fastened to the gill-cover by silver wire.

Of the number of cod marked on Lille Hellefiske Bank in 1948 we have so far received 25 recaptures or 6.7%. 21 of these fish have been recaptured on the bank where they were marked. Two of these were caught the same year, after a lapse of respectively 12 and 54 days, while 19 of them were recaptured during the fishing season of 1949 after a period of freedom of 339—391 days. Of the fish marked on Lille Hellefiske Bank in 1948, 4 specimens have been recaptured on the banks further south, 3 of these on Fyllas Bank after 323—393 days of freedom, and 1 specimen on Fiskenes Bank 62 days after tagging.

Of the 44 cod marked on Store Hellefiske Bank in 1948 no recaptures have been made.

During the summer of 1949 marking of cod was carried out on Store Hellefiske Bank and on Fyllas Bank. In the former locality 15, and in the latter 128, specimens were tagged. The type of tag used was the same as in 1948 but fastened with a stainless steel wire in the gill cover. From the 1949 markings 9 recaptures have so far been recorded. All recaptures consist of fish marked on Fyllas Bank and recaptured on the same bank after 6—74 days of freedom.

It is noticeable that none of the fish marked in 1948 and 1949 have been recaptured in the Greenland Fjords where quite an intensive fishery is going on during the summer. Nor have any recaptures been made on the banks situated to the north of the locality of tagging. The longest southward migration has been undertaken by the fish marked on Lille Hellefiske Bank in 1948 which were recaptured on Fyllas Bank and Fiskenes Bank, an approximate distance of 60 and 120 miles respectively.

BIRGER RASMUSSEN.

Age-Analyses.

Otolith material for age-determination of small cod belonging to the three youngest year-classes has been collected from different localities in northern Greenland. A total of 1028 otoliths have been collected.

The majority of these small cod were taken with small jigs in shallow water close to the shore. Eel hand-seine has been used at four stations. The results of the age-analyses of the different catches are given in Table 8.

Table 8. Age-Analyses.

Locality	Position		Date	Gear	Number	I	II	III	IV	V
	N.	W.				1948	1947	1946	1945	1944
Holsteinsborg.....	66°55'	53°48'	2/7	jig	52	—	48.1	40.4	11.5	—
Agto.....	67°58'	53°33'	4/7	seine	137	—	57.7	33.6	8.8	—
—	—	—	6/9	—	62	1.6	96.8	1.6	—	—
Akugdlit.....	68°39'	51°15'	27/8	jig	64	—	3.1	75.0	21.9	—
Christianshåb.....	68°50'	51°11'	7-8/7	—	99	—	33.3	66.7	—	—
—	—	—	21/7	seine	60	65.0	20.0	15.0	—	—
—	—	—	21-22/7	jig	81	—	48.1	48.1	2.5	1.2
—	—	—	26/8	—	62	—	53.2	45.2	1.6	—
Ritenbenk.....	69°47'	51°18'	27-28/8	—	143	—	57.3	21.7	21.0	—
Kutdligssat.....	70°20'	53°	19/8	seine	105	14.3	80.0	4.8	0.9	—
—	—	—	19/7-18/8	jig	45	—	40.0	22.2	37.8	—
Umanak.....	70°40'	52°	1/8	—	70	—	97.1	2.9	—	—
—	—	—	August	—	23	—	100.0	÷	—	—
Proven.....	72°22'	55°30'	12/8	—	25	—	88.0	—	12.0	—

Table 9. Age-Analyses.

Northern Districts.

Year-Class	1944	1943	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	Total
Age-Group	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	
Number.....	14	105	302	98	96	58	10	15	170	89	406	28	20	21	2	1	1435
%.....	1.0	7.3	21.0	6.8	6.7	4.0	0.7	1.0	11.8	6.2	28.3	2.0	1.4	1.5	0.1	0.1	

Southern Districts

Number.....	49	30	36	16	14	38	37	38	109	38	134	17	17	6	3	1	583
%.....	8.4	5.1	6.2	2.7	2.4	6.5	6.3	6.5	18.7	6.5	23.0	2.9	2.9	1.0	0.5	0.2	

From Table 8 it is seen that the 1947 year-class dominated in the majority of the catches — 10 out of 14. The individuals belonging to the 1945 year-class are of too large a size to be represented among the small cod near the shore. It is evident that the 1947 year-class is

a very rich one which certainly will be of great importance for the commercial codfishery in the future, probably for the first time in 1953. Small cod of the 1947 year-class occurred in large shoals along the coast of NW. Greenland as far as Umanak Fjord, about 70° 40' N.

Table 10. Average Lengths of different Age-Groups of Greenland Cod.

Districts:		Umanak		Jakobshavn		Christiansh�b		Egedesminde		Holsteinsborg		Frederiksh�b		Julianeh�b	
Age-Gr.		N ¹⁾	M	N	M	N	M	N	M	N	M	N	M	N	M
Year-Cl.															
1947.....	♂+♀	114	18.9	—	—	74	19.6	139	19.2	25	19.7	—	—	6	23.7
II															
1946.....	♂+♀	3	27.3	—	—	153	22.0	47	29.8	21	24.6	3	45.0	3	30.3
III															
1945.....	♂+♀	3	26.0	—	—	16	27.6	12	36.1	6	34.3	—	—	—	—
IV.....	♂	—	—	—	—	—	—	—	—	—	—	92	45.4	61	42.0
	♀	—	—	—	—	—	—	—	—	—	—	83	46.5	87	41.9
1944.....	♂+♀	2	50.0	—	—	—	—	—	—	—	—	—	—	—	—
V.....	♂	—	—	—	—	4	52.3	—	—	—	—	3	51.0	19	44.7
	♀	—	—	—	—	2	55.5	—	—	—	—	5	50.0	30	46.9
1943.....	♂	6	58.7	—	—	9	63.7	6	50.3	—	—	3	60.7	12	58.6
VI.....	♀	13	65.5	1	71.0	11	60.4	6	53.7	—	—	2	61.5	19	60.9
1942.....	♂	14	70.4	8	73.1	28	68.7	16	60.1	—	—	2	64.5	13	69.3
VII.....	♀	25	73.4	7	72.4	25	70.7	23	61.7	—	—	10	68.9	15	67.5
1941.....	♂	10	74.9	4	75.5	5	74.2	6	63.0	—	—	3	69.0	8	74.4
VIII.....	♀	17	79.8	9	77.9	15	75.4	8	62.9	—	—	4	74.8	8	73.3
1940.....	♂	10	79.9	10	76.4	10	72.5	6	65.8	—	—	2	76.0	7	72.3
IX.....	♀	14	79.3	19	76.4	8	83.6	4	68.3	—	—	2	86.5	7	77.1
1939.....	♂	9	79.1	12	77.6	5	77.8	—	—	—	—	8	76.6	4	72.8
X.....	♀	8	83.9	15	82.5	1	77.0	1	74.0	—	—	19	77.2	7	79.6
1938.....	♂	—	—	1	88.0	1	75.0	—	—	—	—	13	77.0	4	76.5
XI.....	♀	5	85.6	1	81.0	—	—	—	—	—	—	14	79.7	6	80.8
1937.....	♂	3	79.7	—	—	1	80.0	—	—	—	—	12	78.6	6	84.0
XII.....	♀	—	—	5	84.2	2	87.0	—	—	—	—	11	79.5	9	84.9
1936.....	♂	18	82.8	34	80.3	6	79.8	4	70.0	—	—	29	79.6	12	81.2
XIII.....	♀	31	85.8	43	82.7	10	77.1	5	72.4	—	—	52	81.6	16	81.8
1935.....	♂	12	84.0	20	81.6	1	90.0	2	73.0	—	—	7	79.9	7	78.7
XIV.....	♀	14	90.9	37	85.1	1	87.0	1	70.0	—	—	18	84.4	6	89.0
1934.....	♂	50	86.8	111	84.4	3	83.7	2	72.0	—	—	36	82.5	10	84.6
XV.....	♀	71	90.9	138	86.7	14	88.7	7	78.0	—	—	64	84.8	24	88.0
1933.....	♂	3	83.7	10	85.6	1	84.0	—	—	—	—	3	80.3	1	85.0
XVI.....	♀	7	87.3	4	88.8	2	91.0	—	—	—	—	7	89.0	6	91.3
1932.....	♂	4	87.5	1	83.0	—	—	1	68.0	—	—	6	89.8	2	81.5
XVII.....	♀	8	93.1	5	92.2	—	—	1	78.0	—	—	8	90.5	1	97.0
1931.....	♂	7	92.3	—	—	1	94.0	—	—	—	—	3	89.7	—	—
XVIII.....	♀	9	93.9	4	87.5	—	—	—	—	—	—	1	94.0	2	95.5
1930.....	♂	—	—	—	—	—	—	—	—	—	—	—	—	—	—
XIX.....	♀	1	120.0	1	85.0	—	—	—	—	—	—	1	89.0	2	95.0
1929.....	♂	—	—	—	—	—	—	—	—	—	—	—	—	—	—
XX.....	♀	—	—	—	—	1	139.0	—	—	—	—	—	—	1	82.0

¹⁾ N = Number; M = Average Length in cm.

and more sparsely up to Prøven in Upernavik district, about $72^{\circ} 20' N$. A similar occurrence of the same year-class was also observed in 1948.

This wider distribution of small cod in connection with greater spawning intensity and the great decrease in number of recaptures in Icelandic waters of cod marked in Greenland in recent years seems to indicate that the stock of cod at Greenland has become more acclimated in Greenland waters than formerly.

In Table 9 are given the age-analyses of cod from commercial catches from different fisheries stations along the Greenland coast.

The material, which consists of 2018 age-determinations on otoliths, is separated in two different groups, viz., 1. northern districts from about $62^{\circ} 30' N$. to about $72^{\circ} N$. and 2. southern districts from about $60^{\circ} N$. to $62^{\circ} 30' N$.

The material from the northern districts includes 1435 specimens, while 583 specimens have been examined from the southern districts.

As might be expected from our investigations in recent years the 1934, 1936 and 1942 year-classes dominate in the catches, especially the 1934 year-class, which has been the most important year-class ever known in Greenland waters.

The 1945 year-class seems to be above average judging by the great number of this year-class which were taken in moored nets in a fjord in Frederikshåb district in July. This year-class, however, occurred neither in the commercial catches by long-lines nor in the experimental hauls with the eel hand-seine.

In the former case it was owing to the small size of the individuals (only about 45 cm. in length), in the latter the individuals were too big to be taken with seine near the shore.

In Table 10 are given the average lengths of cod of different year-classes and corresponding age-groups from commercial catches in different districts at Greenland.

The youngest age-groups II and III are taken in seine or with small jig. The average lengths are much lower for both the II and the III-group than the values found by investigations in the northern districts in Greenland in previous years, viz., 24.0 cm. for the II-group and 39.3 cm. for the III-group. These results indicate a reduced growth-rate for the two year-classes 1947 and 1946.

According to Table 10 the average lengths of the 1934 and 1936 year-classes are also lower than the average lengths found in previous years for other year-classes of the corresponding ages.

The younger year-classes, for instance the 1942 (VII-group), agree very well with the average sizes found in earlier years for age-group VII.

The average sizes of these young year-classes seem to be a little lower in Frederikshåb and Julianehåb districts than in the northern districts, but the differences are very small. The Egedesminde district, however, shows the smallest average lengths found for the age-groups VI to IX. The older year-classes also, of which the material is small, seem to have a smaller average size.

PAUL HANSEN.

Comité Atlantique.

Sous-Comités { Plateau Continental Européen,
Plateau Continental Africain,
Méditerranée Occidentale.

INTRODUCTION.

SOUS le titre de «*Comité Atlantique*» ont été rassemblés les résultats préliminaires des observations faites dans le vaste domaine de ce comité s'étendant: depuis la latitude de Saint Kilda, au nord, jusqu' à l'Equateur, au sud, subdivisé en trois secteurs distincts correspondants aux trois sous-comités:

Plateau Continental Européen;
Plateau Continental Africain;
Méditerranée Occidentale.

Dans la présentation de leurs travaux, les auteurs se sont inspirés de l'esprit même des *Annales Biologiques*, défini par le Professeur JOHAN HJORT dans la préface du premier volume des ces annales:

«Réunir tous les résultats importants obtenus dans l'étude des fluctuations de la faune marine, de ses conditions d'existence et de ses modifications en liaison avec celles du milieu ambiant, dans le but de parfaire les connaissances acquises sur la biologie et l'écologie des espèces marines les plus importantes pour l'économie des pêches maritimes dans l'Atlantique Nord».

Les résultats ainsi présentés ne peuvent avoir un caractère définitif. Ils ne couvrent généralement qu'une période d'observations d'une année (année 1949) dans la longue série déjà faites sur ces problèmes variés.

Des observations ultérieures en confirmeront ou infirmeront les conclusions présentes; mais, tels que ces résultats sont sommairement exposés, avec la possibilité pour leurs auteurs de les reprendre dans des publications plus développées, ils assureront, par leur divulgation rapide, une interprétation plus générale des phénomènes observés, l'extension des recherches dans le même domaine, tout en permettant à leurs auteurs de «prendre date» sans attendre la publication définitive de leurs travaux personnels.

Les communications qui nous ont été transmises auraient pu être présentées dans ce volume des *Annales Biologiques* en les groupant par Secteurs Géographiques, correspondant à chacun des trois Sous-Comités du Comité Atlantique.

C'est la solution que nous adopterons volontiers pour les travaux concernant les résultats des recherches sur les conditions physico-chimiques et biologiques du milieu (Hydrologie, Plancton etc.) dès qu'ils auront pris plus d'importance dans les trois secteurs du Comité Atlantique récemment organisé.

Mais, en ce qui concerne les recherches biologiques, nous avons estimé pouvoir grouper par Espèces les travaux les concernant, étant donné: d'une part, l'importance des travaux présentés, et, d'autre part, la présence dans les trois secteurs des mêmes espèces et l'application d'un programme commun de recherches pour leur étude.

JEAN LE GALL.

LES CONDITIONS DE MILIEU

Hydrologie.

Comparaison des Températures de Surface en Manche Occidentale et dans l'Atlantique en 1949.

La comparaison des températures de surface observées en 1949 en Manche Occidentale, en Mer Celtique, dans le Golfe de Gascogne et au large de la Péninsule Ibérique, au cours des croisières du «Président Théodore Tisier», et à bord des frégates météorologiques stationnées au point L (36° N.— 17° W. Gr.), montre: au mois de Mai 1949, une avancée nettement marquée des eaux atlantiques chaudes et salées ($T^{\circ}=14^{\circ}$, 16° et 18° ; salinité supérieure à 35 ‰) au delà du 46° Nord entre les 8° et 9° de Longitude Ouest Greenwich.

Les eaux à 10° et 11° ont, en Manche Occidentale, une extension nettement plus prononcée qu'au cours d'une année normale (définie par les courbes d'isothermie moyenne).

En Août 1949, la situation est encore plus nette. L'isotherme 20° atteint le 46° N. par 12° Long. W. Gr. L'isotherme 19° C. dépasse le 47° N. avec une digitation poussant vers le 48° N. et le dépassant vers le 6° W. Gr.

La température de surface en Manche est de 17° à 18° C. (Moyenne normale 15° à 16° C.).

L. FAURE.

Hydrologie Côtière du Maroc (Année 1948).

Les résultats de l'année 1948 portant sur 4 séries trimestrielles d'observations groupant 225 stations et 835 relevés de températures confirment ceux de 47.

Ils mettent en évidence les mêmes phénomènes: des masses d'eaux différentes, eaux superficielles chaudes d'origine tropicale d'une part, eaux froides d'origine profonde d'autre part, envahissent périodiquement la zone côtière, puis l'évacuent.

Dès le printemps les eaux entrent en mouvement. Celles du large, plus légères et mobiles, les premières se mettent en branle; les «eaux de pente», plus lourdes les suivent un peu plus tard. Leur expansion dans la zone côtière atteint son maximum en été. Puis le mouvement inverse se déclanche: eaux chaudes et eaux

froides regagnent dès l'automne une position d'équilibre.

Les températures de 1948 comparées à celles de 1947 montrent que ces phénomènes se sont exercés avec plus de force que l'année précédente.

Il en est résulté une différence plus tranchée entre eaux d'origine profonde et eaux superficielles du large. Les premières (14° — 16°) ont occupé une plus grande partie de la zone côtière, les secondes, en général moins rapprochées de la côte, avaient une plus grande épaisseur et une température plus élevée (jusqu'à $23^{\circ}5$).

Ces données concordent avec celles qui ont été obtenues dans les mers européennes, où, de la Manche à l'Islande, un afflux plus considérable des eaux Atlantiques a été observé.

Ces phénomènes ont eu leur résonnance sur la biologie des poissons et la pêche: le décalage de la pleine saison 1949 de la pêche à la sardine en avance d'un mois, que nous avions pu annoncer dès Octobre 1948, s'est trouvé vérifié. C'est aussi à ces variations hydrologiques que doit être attribuée l'apparition en automne, près des côtes d'Agadir et Mogador, d'espèces de thons (*Parathunnus obesus* Lowe et *Germo alalunga* GML.) qui se tiennent normalement plus au sud et plus au large.

JEAN FURNESTIN.

Mesure des Courants.

As part of a piece of work aimed at getting into print all unpublished data accruing from the programme of continuous current-measuring operated before World War II (and for a short period into it) from a number of English, French, Netherlands and Danish lightships, a paper at present in the press concerns the Atlantic Slope area. This, by CARRUTHERS, LAW-FORD, and VELEV, reviews over 600 observations continuously recorded aboard the Seven Stones Lightvessel in the vicinity of the Scilly Isles between July, 1939 and April, 1941.

The paper in question is due to appear in the *Journal of the Marine Biological Association* this year. When it has appeared, it is hoped that it will be possible to restart the continuous current-measuring programme.

J. N. CARRUTHERS.

Plancton.

Principales «Espèces Planctoniques» recueillies par la «Ville d'Ys» (1927) et le «Victoria» (1946—47) sur les Bancs de Terre-Neuve.

Le caractère arctique du plancton de Terre-Neuve est accusé par certaines formes boréales telles que: *Calanus hyperboreus* KRÖYER présent aux stations 8 et 9 en Avril et Juin 1947, *Metridia longa* LUBBOCK, présente aux stations 1, 2 et 11 d'Avril et de Juin 1947, *Limacina retroversa* FLEMING présente au sud du Grand Banc en Mars 1947.

Ce plancton contient un nombre restreint de formes.

Calanus finmarchicus GUNNER capturé à presque toutes les stations, *Sagitta elegans* VERRILL abondante généralement de Mars à Mai 1947, *Euthemisto bispinosa* BOECK, capturé aux stations 4, 5, 5₂, 5₃, 7, 8₁, 8₂, 9, 10, 12, 14 en Août 1927 et les Euphausiacées (genres *Thysanoessa* et *Meganyctiphanes*) très fréquentes en 1947 constituent tour à tour les éléments dominants du plancton.

Nous signalons également *Euchaeta norvegica* BOECK capturée en Août 1927 par la «Ville d'Ys» aux stations 4, 8, 8₂ et *Metridia lucens* BOECK, capturée en Mars 1947 par le «Victoria» au sud du Grand Banc (station 1). *Euthemisto compressa* GOËS apparaît en Mars

et en Avril 1947 au sud du Grand Banc et dans le chenal du Flétan. *Clione limacina* PHIPPS est présente en Août et Septembre 1927 aux stations 9, 14 et 15 de la «Ville d'Ys».

JACQUELINE FLEURY.

Répartition des Copépodes

recueillis au cours des pêches planctoniques de surface effectuées à bord du «Président Théodore Tissier» (Juillet 1946).

Au cours de la croisière effectuée par le navire océanographique «Président Théodore Tissier» dans la partie occidentale de la Manche, de nombreuses pêches de plancton ont été pratiquées horizontalement en surface, au filet de soie, au filet de canevas Schmidt, et au petit filet de vitesse décrit par RICHARD (Camp. Scient. Albert Monaco, fasc. LXXXIX), à l'ouest d'une ligne Cap de la Hague — Ile de Wight, dans un secteur limité par le Cap Lizard et le sud de l'Irlande, la Petite Sole et le nord du Golfe de Gascogne (46°46' L.N.).

L'examen des échantillons révèle la présence de Copépodes déjà mentionnée par les auteurs dans la zone de nos investigations. Les espèces déterminées appartiennent à des formes pélagiques et néritiques communes aux mers chaudes, tempérées et froides.

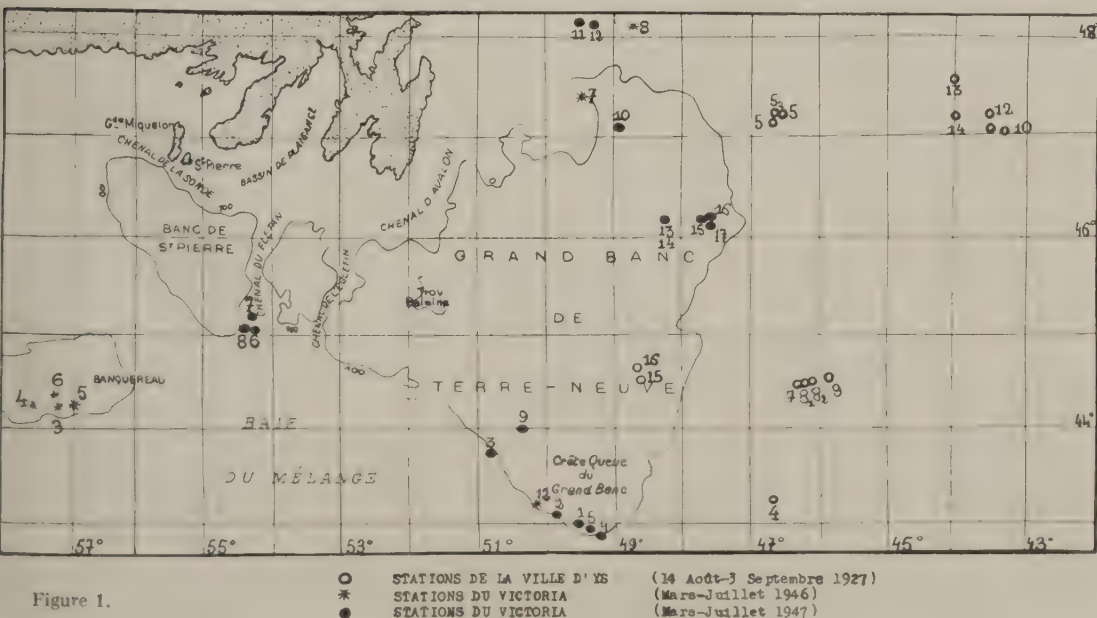


Figure 1.

L'espèce cosmopolite *Calanus finmarchicus* GUNNER est fréquente dans la Manche, l'Atlantique et la côte sud de l'Irlande, mais *Paracalanus parvus* CLAUS, dont les auteurs ont signalé également la vaste répartition, est peu abondante au sud-ouest des côtes Bretonnes, au sud de la Grande Sole et très rare à l'entrée occidentale de la Manche.

Les formes communes aux mers chaudes et froides de l'hémisphère nord sont représentées par *Acartia clausi* GIESBRECHT et *Centropages typicus* KRÖYER, qui prédominent tour à tour ou simultanément à presque toutes nos stations, et également par *Anomalocera patersoni* TEMPLETON distribuée loin des côtes dans les avancées d'eaux chaudes de l'Atlantique à la Manche. Enfin, *Microsetella norvegica* BRADY et ROBERTSON est présente aux stations 14 et 34.

Les récoltes faites dans l'Atlantique et à l'entrée occidentale de la Manche comprennent aussi des espèces propres aux mers tempérées. Mais ces espèces sont peu abondantes.

Nous mentionnons *Oithona nana* GIESBRECHT dans le Raz de Sein, plusieurs *Oncea mediterranea* CLAUS dans la baie d'Audierne, une Sapphirine (sp.) au sud des côtes de

Bretagne et une *Microsetella rosea* GIESBRECHT au sud du Cap Lizard et sur les bancs de la Petite et de la Grande Soles. A la station 33, au sud-ouest de la Pointe de Penmarch, deux pêches effectuées simultanément ont mis en évidence l'existence d'exemplaires mâles et femelles d'*Euchaeta hebes* GIESBRECHT. Ce Copépode a été capturé aussi à la Grande Sole. La relation entre sa distribution et la présence d'une eau de haute salinité se dirigeant à l'entrée de la Manche était admise par FARRAN.

Diverses récoltes renferment des formes de la mer tempérée froide. *Pseudocalanus elongatus* BOECK est présent en petit nombre dans l'Atlantique aux stations 46—47 — 53—54. Un exemplaire de l'espèce *Labidocera wollastoni* LUBBOCK est capturé devant la presqu'île de Crozon. *Coryceus anglicus* LUBBOCK est beaucoup plus fréquent que les précédentes espèces et réparti sur le Banc de la Petite Sole, au sud des côtes d'Irlande et dans la Manche. Il est le seul Corycéide de la Manche (ROSE).

Le Copépode *Metridia lucens* BOECK dont la migration verticale vers la surface au coucher du soleil est bien connue, a été capturé pendant la nuit à des latitudes variant de la



Légende.

- *Acartia clausi*
- *Acartia discadata*
- *Anomalocera patersoni*
- *Calanus finmarchicus*
- *Candacia armata*
- *Centropages hamatus*
- △ *Centropages typicus*
- ▲ *Coryceus anglicus*
- ▲ *Euchaeta hebes*
- ⊕ *Euterpina acutifrons*
- × *Labidocera wollastoni*
- ⊥ *Metridia lucens*
- ⊥ *Microsetella norvegica*
- ⊥ *Microsetella rosea*
- ⊥ *Oithona nana*
- ⊥ *Oithona helgolandica*
- ⊥ *Oithona similis*
- ⊥ *Oncea mediterranea*
- ⊥ *Paracalanus parvus*
- ⊥ *Pseudocalanus elongatus*
- ⊥ *Sapphirine*
- ⊥ *Temora longicornis*

Fig. 2. Relevé des captures effectuées aux diverses stations.



Figure 2 a.

Grande Sole aux côtes d'Irlande. Il est probablement voisin de la limite méridionale de son habitat (CLIGNY).

Euterpina acutifrons DANA est un Harpacticide rencontré très fréquemment dans la Manche et au voisinage des côtes Bretonnes. Il est signalé à deux stations seulement dans l'Atlantique (44 et 45).

Temora longicornis MÜLLER affirme son caractère néritique par son absence de toutes les stations océaniques (particulièrement 1040 à 1049). Lors de notre croisière, il était fréquent dans la Manche à l'ouest de la ligne Cap de la Hague — Ile de Wight, commun à l'entrée de la Manche, présent dans l'Atlantique (côtes ouest de la Bretagne et côtes sud-ouest de l'Irlande). *Centropages hamatus* LILLJEBORG est commun dans la Manche (particulièrement au sud du Cap Lizard) et rare aux stations Atlantiques, ce qui corrobore les opinions de SCOTT, GOUGH, FARRAN, ROSE, sur sa répartition. *Acartia discaudata* GIESBRECHT est également plus néritique qu'*Acartia clausi* GIESBRECHT; elle est fréquente dans la Manche et sur les côtes du Finistère. JACQUELINE FLEURY.

Le Zooplancton de la Zone Côtière du Maroc Année 1948 — 2° note¹).

Il a été procédé, comme en 1947, et suivant les mêmes méthodes à 4 séries trimestrielles

de prélèvements suivant 16 lignes perpendiculaires au rivage, du Cap Spartel au Cap Juby, à raison de 4 récoltes par ligne.

Une étude comparative entre années 1947—48 a suivi l'examen des échantillons:

1) Composition générale et variété du Zooplancton 1948 sont analogues à celles de 1947.

2) Abondance totale légèrement plus élevée en 1948 vu la richesse de l'automne et de l'hiver, malgré la pauvreté estivale.

3) Comme en 1947 maximum de densité du plancton en automne, caractère original de la zone côtière Marocaine.

4) De même, secteurs nord et sud riches, secteur central pauvre.

5) Hiver nettement plus riche qu'en 1947 à cause de l'afflux très précoce des eaux superficielles chaudes du large vers la côte, qui ne se produit habituellement qu'au printemps.

6) La persistance de l'absence de différences notables et cohérentes entre les pêches diurnes et nocturnes nous amène à réduire l'importance attribuée aux migrations journalières verticales du plancton, liées à l'alternance du jour et de la nuit.

7) Par contre les migrations saisonnières constatées témoignent de déplacements importants des formes planctoniques imputables aux mouvements saisonniers des masses océaniques.

8) Parmi les «indicateurs», les Diphyes, Oikopleura, Salpes font partie du plancton de haute mer; les œufs de sardines et anchois du plancton côtier.

9) Notons la position fréquente des Podon (Cladocères) dans les eaux froides, des Evadne (Cladocères) et des œufs d'anchois dans les eaux chaudes.

Conclusion: En 1947—48 la répartition saisonnière et géographique de l'ensemble du zooplancton s'est montrée analogue et sa composition très homogène.

Les observations comparatives portant sur les deux années d'étude paraissent extrêmement fructueuses et dignes d'être poursuivies.

MARIE-LOUISE FAURE.

¹) Note préliminaire, voir Rapp. et Proc.-Verb., Cons. Internat. Expl. Mer, Vol. No. 126, pp. 44—51.

LES POISSONS

GADIDÉS

Merlu (*Merluccius merluccius* (L.)).

Trawling for Hake on Newly Discovered Fishing Grounds.

After the 1939—45 war the catches of hake by English trawlers fishing on the grounds in Region VII to the west and south of Ireland between latitudes 50° N. et 54° N. decreased to such an extent that, by the end of 1949, many hake trawlers were making unprofitable voyages.

In December 1949 a few trawlers sailed from the port of Milford Haven to search for hake on untried fishing grounds. Their search was successful. Considerable quantities of hake were found off the west coast of Africa near latitude 18° N., that is, in Regions XIb and XIIa about 600 miles south of the Canary Islands and over 2,200 miles from Milford Haven. Several trips were made to the newly discovered fishing grounds in December 1949 and January 1950, all with good results. The weight density of hake, as indicated by the catch per 100 hours trawling, was, on the African coast grounds, about fourteen times that on the grounds off Ireland (see below), but, whereas considerable quantities of other fish were caught with the hake on the grounds off Ireland, practically no fish other than hake were caught on the grounds off West Africa.

Landings by Milford Haven Trawlers
in December 1949 and January 1950.

Region	Market Category		Total Land- ings	Hours fishing	Catch per 100 hrs. fishing
	Large	Small			
	cwt.	cwt.	cwt.	cwt.	cwt.
VII b, c, g, h, j & k	1559	10,084	141	11,784	16,653
XI b and XII a	17	6,512	51	6,580	640
					1,028

The hake caught off the African coast were almost all small fish. The length distribution of a sample shows a narrow overall size range of from 35 cm. to 60 cm. with only two of the 349 fish measured being longer than 55 cm. and the great majority being of length between 40 cm. and 52 cm. (Fig. 3). The size range of samples of hake caught at the same time in Region VII was much wider; it extended from 30 cm. to 106 cm., most of the fish being of

length between 30 cm. and 70 cm. The small proportion of large fish on the grounds off Ireland is chiefly due to the effects of sustained heavy fishing—a factor which can hardly have affected the stock of hake about 2,000 miles away to the south.

A. R. MARGETTS.

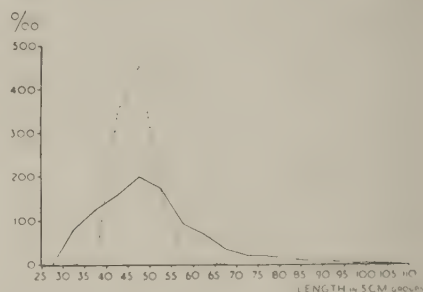


Figure 3. Length distribution of hake from fishing grounds off Ireland (continuous line) and off African coast (dotted line).

Le stock dans le Golfe de Gascogne en 1949.

En 1949 le rendement de la pêche du merlu dans le Golfe de Gascogne et en Mer Celtique a été encore en diminution sur celui des années précédentes. La moyenne annuelle des captures de merlu ne fut que de 6,3 tonnes par marée pour un chalutier hauturier à vapeur contre 8,9 tonnes en 1948 et 23,3 tonnes en 1946. Ce déclin laisse facilement prévoir que nous entrons à nouveau dans un cycle de mauvaises années de pêche par épuisement du stock.

Les mensurations montrent que le stock exploité en 1949 allait de 35 à 110 cm. mais

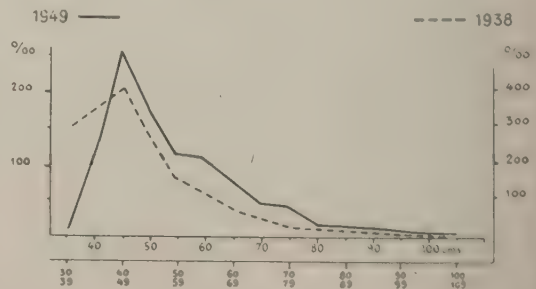


Figure 4.

que la plus grande partie des captures (100 à 250 ‰) était composée de poissons ayant de 40 à 55 cm. (maximum 45 cm.). De 55 à 65 cm. on trouvait encore d'assez nombreux merlus (100 à 75 ‰) mais au delà la courbe représentative tombe rapidement au dessous de 50 ‰ des captures. Cette courbe est tout à fait comparable à celle que nous pouvons construire d'après les chiffres publiés par HICKLING pour 1938 (Fish. Invest. Ser. II., Vol. XVII, n° I, p. 59, tabl. X).

L'examen en Mars d'un lot de 250 otolithes prélevés dans le Golfe de Gascogne montre que le groupe dominant est formé de merlus allant avoir cinq ans (classe 1944) et dont la taille

moyenne est de 45 cm. ce qui correspond au résultat des mensurations. Viennent ensuite la classe 1943 qui va avoir six ans et a une taille moyenne de 51 cm. puis les classes 1945—42 et 41 qui avec des tailles moyennes de 42.61 et 68 cm. composent la grande majorité du stock soit 90% du matériel étudié.

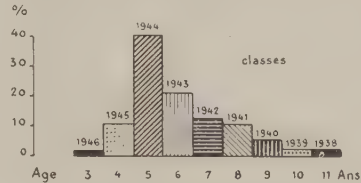


Figure 5.

Répartition par classes des merlus du Golfe en 1949.

(Prélèvement effectué du 28. II. au 4. III. 1949 par 47° 10 et 5° 40 Grw.).

Classe:	1946	1945	1944	1943	1942	1941	1940	1939	1938+
Age:	3	4	5	6	7	8	9	10	11+
cm./	40.....	1	13	18	—	—	—	—	—
	45.....	—	10	57	13	—	—	—	—
	50.....	—	—	23	23	—	—	—	—
	55.....	—	—	1	12	5	1	—	—
	60.....	—	—	—	2	12	2	—	—
	65.....	—	—	—	2	9	4	—	—
	70.....	—	—	—	—	2	13	—	—
	75.....	—	—	—	—	1	4	5	1
	80.....	—	—	—	—	—	—	3	—
	85.....	—	—	—	—	—	—	1	—
	90.....	—	—	—	—	—	—	2	3
Total.....	1	23	99	52	29	24	9	3	3
%	1	10	40	21	12	10	4	1	1
Taille moyenne	40	42	45	51	61	68	77	85	90 cm.

Mensurations effectuées en mer.

Origine	Sud Grande Sole 300—350 m. 48° 45—9° 40 23—25. II.	Golfe de Gascogne 200—300 m. 47° 10—5° 40 28. II.—4. III.	Moyenne
cm.	35	16	11
	40	101	115
	45	254	269
	50	215	164
	55	130	117
	60	110	111
	65	58	77
	70	38	49
	75	34	37
	80	16	15
	85	10	12
	90	8	9
	95	5	8
	100	4	4
	105	1	1
	110	—	1
Total	1000	1000	1000

Le stock exploité en 1949 se composait donc de poissons ayant de trois à onze ans et plus mais, en fait, ce sont ceux de quatre à huit ans qui donnent la plus grande partie des apports et principalement ceux de cinq et six ans qui, à eux seuls, fournissent 60% de la pêche.

R. LETACONNOUX.

Le Merlu des Côtes du Maroc.

(Résumé).

- I. Mensuration des merlus capturés au chalut à Casablanca en Mars 1949 (maille de 10 mm.):
à la profondeur de 40 à 60 m. Taille de 11 à 38 cm. Nombre: 883
à la profondeur de 150 à 200 m. Taille de 12 à 95 cm. Nombre: 712.
- II. Caractères métriques de merlus de taille comprise entre 10 et 25 cm. (n: 223. Taille moyenne: 14.6 cm.).

	Indice long. latérale tête: 100 T L.T	Indice distance pré- dorsale: 100 D L.T	Indice distance pré- anale: 100 A L.T
Fréquence.....	25 à 30	26 à 31	36 à 43
Mode	27	28	40
Moyenne	27.29	28.08	39.65
$\sigma \pm$	0.86	0.80	0.92
Fl.m. $\pm$	0.18	0.178	0.20

III. Caractères numériques

(pour D1 et D2: n: 223)

(pour vertèbres: n: 256)

	No. de rayons 1 Dorsale: D1	No. de rayons 2 Dorsale: D2	No. de vertèbres
Fréquence.....	9 à 11	35 à 40	49 à 53
Mode	10	38	51
Moyenne	9.94	38.06	50.58
$\sigma \pm$	0.36	3.27	0.72
Fl.m. $\pm$	0.08	0.72	0.047

CLAUDE MAURIN.

PLEURONECTIDÉS

Sole (*Solea solea* (L.)).

La Sole des Côtes de Bretagne.

(Manche occidentale et Atlantique).

Des soles de petite taille sont pêchées, de Mai à Octobre, dans les pêcheries fixes, ou «bouchots» de la Baie du Mont Saint-Michel. D'après CHEVEY, ces soles mesurent, en Mai-Juin: 9 à 13 cm.; en Juillet: 4.1 à 7.2 cm.; en Août: 3.5 à 10 cm.; en Septembre-Octobre: 8.8 à 10.7 cm. Leur maximum d'abondance à la côte se présente en Août.

De même, le chalut à crevettes capture au printemps et en été des immatures de Pleuronectes, parmi lesquels des soles.

A la suite d'enquêtes récentes sur la nocivité de ces engins de pêche, effectuées par M. L. FAURE et M. J. MORICE, nous avons pu nous procurer du matériel provenant des pêcheries de la Baie du Mont Saint-Michel en 1947, et de la côte sud de Bretagne (embouchure de la Vilaine), en 1949.

1. Taille et âge.

Le Tableau 1 indique la répartition des tailles et le nombre d'anneaux d'hiver inscrits sur les otolithes des soles pêchées en Baie du Mont Saint-Michel en Juillet 1947; à l'embouchure de la Vilaine, au chalut à crevettes, par 5 à 10 mètres de fond, en Avril, Juin et Septembre 1949; enfin, à Roscoff en Août 1949.

Il montre nettement 3 groupes de tailles séparés par les longueurs de 9—10 cm. et 18 cm. En Juin-Juillet, les régions littorales sont peuplées par des soles nées l'année même, mesurant 2 à 9 cm., conformément aux pêches antérieures de CHEVEY en Juillet-Août dans les mêmes parages. D'Avril à Septembre, on y trouve des soles mesurant 10 à 16 cm. et âgées d'un hiver, ainsi que des poissons de 19 à 22 cm. âgés de deux hivers.

Les soles nées dans l'année même (groupe 0) mesurent, en majorité 4 à 7 cm. à la fin de Juillet, ce qui s'accorde avec les observations minutieuses de FABRE-DOMERGUE et BIETRIX: les naissances ont lieu de Février à Juin, à la taille de 3.2 mm. et les jeunes ont une longueur de 4 cm. environ à 3 mois.

Notre groupe I (soles nées l'année précédente) a une taille modale de 12 cm. en Avril, 14 cm. en Juin, deux mois plus tard. Cet accroissement de 1 cm. par mois, s'il se maintient jusqu'en Octobre ou Novembre

donne 18 ou 19 cm. comme taille probable vers la fin de la période de croissance annuelle.

Les mensurations de soles immatures pêchées l'hiver, dans les estuaires de la région de Plymouth avaient donné à HARTLEY 2 groupes distincts: l'un de 6 à 12 cm. (taille moyenne: 9.9 cm.), l'autre de 15 à 16 cm. (taille moyenne: 15.7 cm.). D'après notre tableau, ces groupes sont respectivement à leur premier et à leur second hiver d'existence.

Tableau 1. Tableau de Répartition par Taille et par Âge.

Date	10-29/7-47	5/4-49	2/6-49	15-30/8-49	19/9-49	Nom- bre d'an- neaux d'hiver.
Lieu	Mt.St-Mi- chel	Vilaine	Vilaine	Roscoff	Vilaine	
Nombre Taille en cm.	296	49	92	3	5	
2	3	—	—	—	—	0
3	12	—	—	—	—	
4	33	—	2	—	—	
5	74	—	—	—	—	
6	113	—	—	—	—	
7	36	—	—	—	—	
8	18	—	—	—	—	1
9	5	—	—	—	—	
10	2	3	1	—	—	
11	—	12	2	—	—	
12	—	19	7	—	1	
13	—	5	24	—	3	
14	1	4	38	—	—	2
15	—	—	17	—	—	
16	—	—	1	—	—	
17	—	1	—	—	—	
18	—	—	—	—	—	
19	—	—	—	1	—	
20	—	2	—	1	—	2
21	—	2	—	1	1	
22	—	1	—	—	—	

Les résultats confirment les observations de BÜCKMANN sur la taille moyenne des soles du sud-est de la Mer du Nord, à la fin de chaque période de croissance (groupe 0: = 8 cm., groupe I: = 19 cm.; groupe II: = 24.4 cm. — 26 cm.), celles, antérieures, de TESCH (groupe 0 = 9 cm, groupe I = 18 cm.; groupe II = 25 cm.), confirmées depuis par SCHMIDT.

En Août, les jeunes soles du groupe 0 mesurent dans le sud de la Mer du Nord, 4.5 à 6.4 cm. (EHRENBAUM); dans le Kattegat: 3 à 4 cm., (maximum 6—7 cm.), tandis que celles du groupe I ont 13 à 15 cm. de longueur (JOHANSEN).

La croissance de la sole sur les côtes de Bretagne, au cours des 3 premières années, est donc analogue à celles du sud de la Mer du Nord et du Kattegat.

2. Maturité sexuelle.

Tous les poissons des groupes I et II sont immatures; les plus petites femelles mûres observées mesurent 26 cm. fin Avril (stade V de HJORT); 27.5 cm. en Août (ponte terminée). Elles sont âgées de 3 hivers.

D'après HOLT et MOHR, en Mer du Nord, les premières femelles à maturité ont: 26.7 et 27 cm. et il y a des immatures jusqu'à la longueur de 32 cm. BÜCKMANN a trouvé des femelles mûres à partir de 24 cm. et des immatures jusqu'à 31 cm., la séparation entre adultes prédominants et immatures se faisant à la taille de 27 cm.

3. Formule vertébrale.

La formule vertébrale ci-dessous a été établie d'après 136 exemplaires nés en 1948 (groupe I), provenant de la côte sud de Bretagne en 1949.

vertèbres	Nombre de exemplaires	Mode = 50
47	1	Moyenne = 50.34
48	1	
49	14	$\sigma = \pm 0.810$
50	60	
51	54	Fl. = ± 0.23
52	6	Fl.m. = 50.11 à 50.57

MOHR avait obtenu pour les soles de l'embouchure de l'Elbe un mode vertébral: 48 et une moyenne de 47.55 (± 0.06); pour les soles du Kattégat: le mode 47 et la moyenne 47.21 (± 0.03). Les soles de la côte Atlantique française auraient donc, la plupart, 3 vertèbres de plus qu'au Kattégat et 2 de plus qu'en Mer du Nord.

P. DESBROSSES.

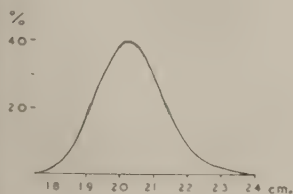


Figure 6. The length-frequency curve for the Cornish pilchards in 1949.

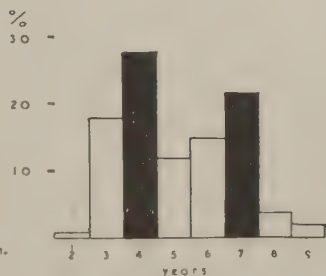


Figure 7. The age composition of the Cornish pilchard shoals in 1949.

CLUPÉIDÉS

Sardine (*Clupea* = *Sardina pilchardus* WALB.).

The Cornish Pilchard.

During the 1949 season, 900 pilchards from the Cornish drift-net fishery were examined at the Lowestoft Laboratory, and the details of the examination are as follows:

Length.

The length-frequency curve of the 900 fish is shown in Figure 6.

The measurements form an almost perfectly symmetrical curve, the mode of which is at 230 mm.

Age.

Figure 7 shows the age-distribution of the 891 fish whose scales were suitable for reading.

The predominating groups are those whose ages are four and seven years respectively and it is interesting to note that the age-distribution is similar to that of the East Anglian herrings in 1949.

In 1947, when the investigation into the composition of the Cornish pilchard shoals began, it was found that there were two main groups aged two and five years, and in 1948 these groups were present as three and six-year-old fish so it would seem that these adult pilchards remain together in northern waters until they die. If this proves to be the case, it should be possible to calculate the rate of mortality, and once this is known, the forecasting of the fishery should also be possible.

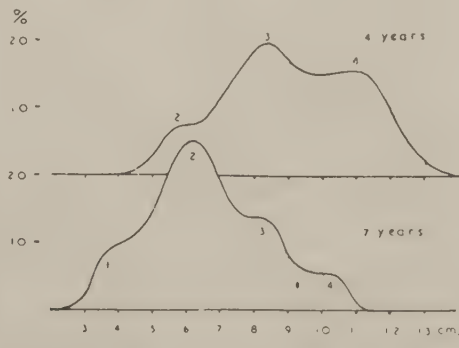


Figure 8. The calculated length l_1 for the four- and seven-year-old pilchards in 1949.

Length l_1 .

The length, l_1 , has been calculated from 238 scales with four growth zones, and from 181 scales with seven growth zones, and the result of this examination is shown in Figure 8.

It will be seen that the two length curves are multi-modal and for the sake of clarity, the modes have been numbered 1, 2, 3, and 4 according to size. The shape of these two curves is consistent with the very lengthy spawning period of the pilchards of the Channel, and it is considered probable that the modes are the result of different maxima in the spawning cycle. The routine search for newly-liberated eggs which is being carried out by the research ship "Sir Lancelot" is proving that the spawning takes place throughout the whole length of the Channel and by the end of 1950 it is hoped that the duration of the spawning in each locality will be known.

The two curves in Figure 8 suggest that there is a great difference in the effectiveness of the various spawnings from year to year.

Vertebrae.

The average number of vertebrae, as calculated from 594 fish was 51.997, which agrees well with FURNESTIN's figure of 52 for this "race" of pilchards.

W. C. HODGSON.

Pêcheries du Golfe de Gascogne.**I. Origine: Belle-Isle**

Date: 15—17 Février 1949

Engin de capture: Bolinche

Taille.	Répartition %										
cm.	13	14	15	16	17	18	19	20	21	22	
No. %	0.6	3.3	6.7	19.3	42.7	18.0	2.7	5.4	0.6	0.7	
N: 151 et 252											
+ 1 individu taille exceptionnelle 26 cm.											
Mode = 17 Moyenne = 17.5 cm.											

Moyenne vertébrale.

Vertèbres	50	51	52	53	54
No. %	0.4	13.2	67.8	17.0	0.8
N = 252					
Mode = 52					
Moyenne = 52.05 Fl.m. = ± 0.12					

Observateurs: FAURE et POISSON.

Taille. (III)

		Répartition %										
cm.		11	12	13	14	15	16	17	18	N	Mode	Long. moyenne
Nombre % a		0.4	3.0	30.7	29.1	16.4	18.9	1.5	—	535	13 et 16	14.21
b		7.8	26.6	24.4	22.9	10.9	3.3	3.7	0.8	458	12	13.21

Température sur les lieux de pêche: T° surf. = 19.4°C. le 16/9/49
18.2°C. le 16/10/49.

Observateur: E. P. PRIOL.

II. Origine: La Rochelle

Date: 15 Juin 1949

Engin de capture: Filets droits

Taille.

Moyenne comparée aux résultats 1947 et 1948

Longueur totale mm.	Taille à L_1	N
Juin 1947	105	74 mm. 159
» 1948	129	83 » 200
» 1949	121	75 » 100

Moyenne vertébrale des individus à faible valeur de L_1 .

Juin 1947.....	52.03	N = 159
Juin 1948.....	52.05	N = 200
Juin 1949.....	52.05	N = 100

Résultats montrant la fixité du caractère depuis 1947.

III. Origine: Côte sud du Finistère, Baie de Concarneau. 2 milles est Ile aux Moutons

Date: a) 15 Septembre 1949

Engin de capture: Bolinche

b) 15 Octobre 1949

Engin de capture: Bolinche.

Taille (voir au bas de la page.)

IV. Considérations générales.

Dans ces échantillons, prélevés en trois régions et à des époques différentes, les classes modales 12—13 représentent les sardines du groupe I, un an révolu, classe 1948, apparaissant sur la côte de Vendée dès le mois de Juin et un peu plus tard, dès le début de Juillet, sur la côte sud de Bretagne.

Les classes modales 16 et 17, représentent les sardines du groupe II, deux ans révolus, classe 1947 en ce qui concerne celles de la Baie de Concarneau et classe 1946 pour celles de Quiberon-Belle Isle dont la présence en hiver dans cette région peut être considérée comme exceptionnelle. Il convient de noter parmi ces dernières la présence de sardines du groupe III, classe 1945 (deuxième classe modale).

JEAN LE GALL.

Côte Basque.

La durable crise sardinière que subissent les côtes nord et nord-ouest d'Espagne empêche l'étude méthodique de l'espèce. Cependant, c'est précisément cette circonstance qui justifie l'intérêt de publier les données acquises, tout insignifiantes qu'elles soient; d'autant plus que depuis l'été de 1944 aucune étude n'a été faite sur la sardine de cette région.

Origine du matériel.

Trois échantillons (chacun de 100 poissons), pêchés au filet tournant et à la rogue au large de Zarauz (le 11 Juin 1948), de Guétaria (le 14 Octobre 1948) et de Fuenterrabia (le 24 Mars 1949).

Tableau 2. Sardine.

A. Taille et Poids.

a) Taille mm.	Côte Basque.				
	1948		1949	Poids gr.	
	11.VI	14.X	24.III	14.VI.48	24.III.49
130	—	4	2	—	13.5
135	—	—	15	—	17.2
140	—	—	24	—	19.6
145	6	—	12	24.1	21.2
150	4	2	13	27.0	24.1
155	8	—	15	29.7	27.5
160	20	2	9	32.4	29.0
165	39	14	6	35.8	32.0
170	19	28	2	38.2	34.5
175	3	1	2	45.3	37.5
180	1	6	—	50.0	—
185	—	2	—	—	—
Moy.	163	170	148	—	—

Taille et poids.

La longueur totale, mesurée au millimètre a été ramenée au demi-centimètre le plus proche. Les poids moyens du Tableau 2 Aa se rapportent aux classes de tailles ainsi établies.

Les deux premiers échantillons, dont la taille moyenne respective est 16.3 et 17.0 cm., rassemblent évidemment des sardines âgées

(suite p. 60)

b) Côte de Santander.

Taille mm.	1948			1949							Total
	13.X	2.XI	18.XI	5.IV	28.IV	9.VI	1.VII	21.VII	11.VIII	19.X	
115	—	—	—	—	—	—	—	—	—	3	3
120	—	—	—	—	—	—	—	—	—	6	6
130	—	—	—	—	—	—	—	—	—	3	3
135	—	—	1	—	—	—	—	—	—	3	4
140	—	—	3	2	—	—	—	—	—	9	14
145	—	1	8	4	—	—	—	—	—	28	41
150	—	2	15	10	2	—	15	—	—	33	77
155	—	3	7	32	5	8	19	—	—	9	83
160	1	2	8	41	15	33	28	2	—	7	137
165	—	—	—	11	25	25	31	16	—	1	112
170	—	—	2	4	22	30	11	41	2	1	113
175	2	—	1	1	22	2	—	30	14	—	72
180	22	7	11	—	11	2	1	11	24	—	89
185	21	11	13	—	1	—	—	4	30	—	80
190	26	20	20	—	2	—	—	1	20	—	89
195	16	19	6	—	—	1	—	—	8	—	50
200	3	11	5	—	—	—	—	—	3	—	22
205	5	10	2	—	—	—	—	—	2	—	19
210	4	10	2	—	—	—	—	—	—	—	16
215	1	6	1	—	—	—	—	—	2	—	10
220	3	2	—	—	—	—	—	—	—	—	5
230	—	2	—	—	—	—	—	—	—	—	2
N.	104	106	105	105	105	104	105	105	105	103	1047
T.											
moy.	190	194	174	158	169	164	160	172	186	145	

c)

Taille mm.	1948		1949					Total	N.
	Octobre	Novembre	Avril	Juin	Juillet	Août	Octobre		
115	—	—	—	—	—	—	15.3	15.3	3
120	—	—	—	—	—	—	15.1	15.1	6
130	—	—	—	—	—	—	21.0	21.0	3
135	—	18.0	—	—	—	—	22.3	21.2	4
140	—	22.7	22.5	—	—	—	24.8	24.0	14
145	—	23.8	24.5	—	—	—	27.2	26.2	41
150	—	27.4	28.1	—	30.1	—	30.0	29.3	74
155	—	28.6	30.8	34.1	33.4	—	34.3	31.9	81
160	35.0	33.0	32.8	36.4	35.5	—	37.3	34.7	130
165	—	—	36.8	39.5	38.3	—	40.0	38.2	110
170	—	—	40.3	44.9	42.2	46.5	45.0	42.6	113
175	50.0	—	43.7	48.5	45.2	50.3	—	46.0	71
180	55.2	52.8	47.2	51.5	47.6	52.4	—	51.7	84
185	58.8	55.2	47.0	—	52.7	56.0	—	56.1	78
190	62.1	59.2	54.5	—	—	59.3	—	60.0	84
195	68.0	64.3	—	60.0	—	65.2	—	65.5	51
200	72.3	68.7	—	—	—	68.0	—	69.1	22
205	74.2	73.9	—	—	—	73.3	—	73.9	20
210	80.7	79.5	—	—	—	—	—	79.7	15
215	85.0	84.3	—	—	—	85.0	—	84.4	9
220	78.0	94.0	—	—	—	—	—	84.4	5
230	—	97.5	—	—	—	—	—	97.5	2

Tableau 2 A suite.

2 A d

Echantillon

No.

Date

N

Min.

Moy.

Max.

1.

14-II

121

123

140

202

2.

24-II

100

108

125

175

3.

10-III

100

119

142

176

4.

10-III

100

112

138

183

5.

26-III

100

129

137

152

6.

9-IV

100

120

131

143

7.

26-IV

100

127

140

155

8.

11-V

100

138

149

175

9.

24-V

100

137

148

167

10.

15-VI

100

147

168

196

11.

30-VI

100

147

162

184

12.

13-IX

116

131

155

196

13.

11-X

100

118

140

181

14.

27-X

100

125

146

165

15.

16-XI

100

118

145

181

16.

29-XI

111

121

157

201

17.

22 XII

100

123

135

154

Vigo.

Tailles

Min.

Moy.

Max.

123

140

202

108

125

175

119

142

176

112

138

183

129

137

152

120

131

143

127

140

155

138

149

175

137

148

167

147

168

196

147

162

184

131

155

196

118

140

181

125

146

165

118

145

181

121

157

201

123

135

154

g)

Portugal.

Fréquence des Tailles (‰), par Classes d'Age, dans l'Ensemble des Echantillons de la Sardine de Lisbonne étudiés pendant les Hivers de 1947/48 et 1948/49.

L

(cm.)

C 0

C I

C II

C> II

Total

(A)

(B)

47/48

48/49

47/48

48/49

47/48

48/49

47/48

48/49

7.5

8.1

—

4

—

—

—

—

1

8.0

.7

—

2

—

—

—

—

—

.5

9.3

—

6

—

—

—

—

—

9.0

.8

—

21

—

—

—

—

13

.5

10.4

—

37

—

—

—

—

22

10.0

.9

—

104

—

—

—

—

63

.5

11.5

11

114

—

—

—

—

3 68

11.0

12.0

31

116

—

—

—

—

7 70

.5

.6

114

98

—

—

—

—

26 59

12.0

13.1

179

71

—

—

—

—

41 43

.5

.7

202

23

—

—

—

—

47 14

13.0

14.2

182

19

—

—

—

—

42 12

.5

.8

131

25

—

—

—

—

30 15

14.0

15.4

97

64

3

—

—

—

24 38

.5

.9

31

112

23

4

—

—

23 68

15.0

15.6

11

117

73

4

8

—

52 72

.5

17.0

8

52

163

73

26

12

—

113 53

16.0

.6

3

13

268

250

43

23

—

184 82

.5

18.1

—

2

238

250

43

81

—

163 81

17.0

.7

—

—

144

202

137

174

—

107 75

.5

19.2

—

—

74

129

214

232

182

—

70 60

18.0

.8

—

—

11

73

256

221

121

125

29

44

.5

20.3

—

—

2

12

154

163

273

125

19

22

19.0

.9

—

—

4

94

93

364

250

15

13

.5

21.4

—

—

—

26

—

60

250

4

2

20.0

22.0

—

—

—

—

—

60

250

—

2

n =

352

519

1021

248

118

87

33

8

1524

862

‰

231

602

670

288

77

101

22

9

1000

Longueur (A) — Jusqu'à la fourche de la nageoire caudale (centre de la classe).

Longueur (B) — Longueur totale, caudale comprise, correspondante à la longueur (A).

e)

Vigo.

Taille

Févr.

Mar.

Avr.

Mai

Juin

Sept.

Oct.

Nov.

Dec.

Total

105

0.9

—

—

—

—

—

—

—

—

0.1

110

4.5

0.6

—

—

—

—

—

—

—

0.6

115

7.2

1.0

—

—

—

—

0.5

0.4

—

1.2

120

15.3

6.3

2.0

—

—

—

6.5

2.3

2.0

4.4

125

13.5

16.3

16.5

—

—

—

9.5

2.3

9.0

8.2

130

19.4

17.6

27.0

—

—

7.7

9.0

10.4

39.0

13.6

135

11.3

18.3

26.5

3.0

—

17.2

10.5

14.2

31.0

13.7

140

8.5

9.3

18.5

22.0

—

20.6

17.0

21.8

10.0

13.8

145

5.4

4.6

8.0

39.0

1.5

9.4

22.0

21.3

5.0

13.0

150

4.9

7.0

1.0

25.0

3.0

6.0

14.0

11.3

4.0

9.0

155

3.1

6.6

0.5

6.0

21.5

—

2.0

4.7

—

5.5

160

0.9

8.0

—

1.0

31.5

2.5

3.5

1.4

—

5.9

165

2.2

2.3

—

1.5

13.0

2.5

0.5

1.4

—

2.7

170

—

0.6

—

1.5

10.0

6.8

2.0

0.9

—

2.2

175

0.9

0.6

—

0.5

10.0

4.3

1.5

1.4

—

2.0

180

0.9

0.3

—

—

6.0

12.0

1.5

1.8

—

2.0

185

—

—

—

—

1.5

6.0

—

0.9

—

0.6

190

—

—

—

—

—

2.5

—

1.4

—

0.2

195

—

—

—

—

0.5

1.7

—

1.4

—

0.3

200

0.4

—

—

—

—

—

—

0.4

—

0.1

N=221

300

200

200

200

116

200

211

100

1748

h)

Malaga.

Taille

mm.

28 III

20 VI

19 X

22 XII

19 I

Total

115

—

1

1

—

—

0.4

120

—

4

1

10.0

—

2.7

125

9

36

—

13.8

5

12.3

130

12

38

1

16.3

8

15.0

135

9

15

2

11.3

13

10.0

140

12

6

15

8.8

5

9.4

145

15

—

31

5.0

15

13.6

150

24

—

20

3.7

14

12.7

155

11

—

21

3.7

9

9.2

160

6

—

7

3.7

13

6.1

165

2

—

1

6.3

9

3.5

170

—

—

—

3.7

2

1.1

175

—

—

—

5.0

3

1.5

180

—

—

—

6.3

3

1.7

185

—

—

—

—

1

0.2

190

—

—

—

1.2

—

0.2

205

—

—

—

1.2

—

0.2

N

100

100

100

80

100

480

Moy.

143

129

148

144

150

143

f)

Vigo.

Taille

P

P¹

Taille

P

P¹

mm.

gr.

gr.

mm.

gr.

gr.

105

6.5

5.0

155

32.2

26.8

110

7.9

7.3

160

36.4

30.7

115

11.1

8.8

165

38.5

31.5

120

14.3

11.4

170

42.6

37.5

125

16.6

13.5

175

45.9

39.1

130

18.5

15.2

180

49.9

42.1

135

20.5

17.3

185

55.0

—

140

23.2

19.4

190

56.5

—

145

25.5

21.5

195

60.5

—

150

27.9

22.7

200

70.5

—

Tableau 2 A suite.

i)	Baléares.			
	1948	1949		
Taille mm.	Nov.	Févr.	Mars	Total
155	5.5	—	1.8	3.1
160	6.2	4.3	3.7	5.1
165	19.2	3.3	14.8	13.4
170	17.1	3.3	16.7	12.7
175	14.4	7.6	27.8	14.7
180	10.9	9.8	14.8	11.3
185	11.6	11.9	9.3	11.3
190	4.8	10.9	7.4	7.2
195	4.1	10.9	3.7	6.1
200	6.2	14.1	—	7.5
205	—	14.1	—	4.5
210	—	7.6	—	2.4
215	—	2.2	—	0.7

B. Caractères Sexuels.

a)	Côte Basque.			b)	Santander.			
	1948		1949		Date	Mâles		Femelles
	11-VI	14-X	24-III	1948	Nombre	Taille moy.	Nombre	Taille moy.
♂: Nombre.....	52	46	40	13-X	32	185	72	190
♂: Taille moyenne en mm.....	161	171	146	2-XI	31	186	75	200
♀: Nombre.....	48	54	60	18-XI	39	174	66	174
♀: Taille moyenne en mm.....	164	169	148	1949				
Maturité sexuelle:				5-IV	38	154	67	160
Stade I en %	0	0	8	28-IV	3	169	102	169
— II —	58	6	20	9-VI	63	163	41	166
— III —	32	44	37	1-VII	65	161	40	159
— IV —	10	48	35	21-VII	57	172	48	172
— V —	0	2	0	11-VIII	24	181	81	188
Engraissement viscéral:				19-X*)	42	149	39	172
Degré I en %	0	2	24					
— II —	0	6	64					
— III —	50	58	12					
— IV —	50	34	0					

*) En plus, 22 poissons à sexe imprécis (taille moyenne 131 mm.).

*) En plus, 22 poissons à sexe imprécis (taille moyenne 131 mm.).

c)	Santander.										d)	Vigo.								
Date	Nombre des sardines aux divers stades de maturité								Maturité moyenne		Poids moyen des gonades		Date	Mâles			Femelles			Juv.
	I	II	III	IV	V	VI	VII	VIII	♀♀	♂♂	♀♀	♂♂	1949	N	M.T.	M. S.	N	M.T.	M.S.	N
													14-II	86	138	5.1	32	146	3.8	3
													24-II	35	129	3.6	18	134	3.2	47
													10-III	56	140	5.4	43	145	4.6	1
1948								(II)					10-III	50	132	2.6	37	150	4.3	13
13-X	—	3	46	36	16	3	—	—	III-9	III-7	1.60	0.83	26-III	44	136	1.8	55	138	1.9	1
2-XI	—	13	25	41	20	7	—	—	III-9	III-6	2.37	1.53	9-IV	32	133	1.0	47	131	1.2	21
18-XI	24	17	2	54	3	5	—	—	III-0	III-2	1.58	1.67	26-IV	40	140	1.6	55	140	1.5	5
1949													11-V	46	148	3.3	54	150	2.9	—
5-IV	—	—	—	—	—	85	20	—	VI-2	VI-2	1.11	0.97	24-V	62	148	3.9	37	148	2.5	1
28-IV	—	—	—	3	7	68	27	—	VI-1	VI-0	1.95	2.59 ¹	15-VI	47	162	6.3	53	173	5.4	—
9-VI	—	—	—	—	1	75	28	—	VI-4	VI-2	1.78	1.74	30-VI	79	160	4.6	21	166	3.9	—
1-VII	26	68	11	—	—	—	—	—	I-8	I-9	0.20	0.22	13-IX	23	170	1.4	44	164	1.5	49
21-VII	3	85	9	2	6	—	—	—	II-1	II-4	0.25	0.41	11-X	22	155	1.3	27	142	1.1	51
11-VIII	—	—	—	—	—	—	5	100	VII-9	VII-9	0.41	0.19	27-X	60	147	1.4	36	144	1.4	4
19-X ²	39	34	10	—	—	—	—	—	I-6	I-7	0.14	0.12	16-XI	48	146	2.4	50	145	2.2	2
													29-XI	54	145	3.3	56	150	3.1	1
													22-XII	45	135	3.2	50	136	3.1	5

¹ Trois poissons seulement.
² En plus, 22 jeunes à sexe imprécis.

¹ Trois poissons seulement.

² En plus, 22 jeunes à sexe imprécis.

N = nombre — M.T. = taille moyenne.
M.S. = maturité sexuelle empirique moyenne.
Juv. = sardines à sexe imprécis.

Tableau 2 B suite.

e) Vigo.				g) Malaga.			
Taille	♂♂	♀♀	??	Taille	♂♂	♀♀	??
105	—	—	0.9	155	8.5	3.6	—
110	0.1	0.1	4.9	160	7.4	5.4	1.4
115	0.2	0.1	8.9	165	2.6	3.6	—
120	3.9	1.6	15.3	170	1.9	3.0	0.4
125	7.5	6.4	17.8	175	1.4	3.2	0.4
130	13.3	12.5	17.3	180	2.1	2.5	—
135	13.4	14.1	13.8	185	0.3	1.2	—
140	13.3	15.9	8.3	190	0.1	0.5	—
145	12.6	15.0	7.4	195	—	0.8	—
150	10.3	9.3	1.9	200	0.1	0.1	—
N = 830				716 202			

Stades				Malaga.			
				1949			
				28-III	20-VI	19-X	22-XII
				—	100	100	5.0
II				—	—	—	10.0
III				—	—	—	21.2
IV				—	—	—	27.5
V				—	—	—	22.5
VI				3	—	—	13.8
VII				61	—	—	—
VIII				36	—	—	—

h) Baléares.				Stades de maturité			
				II	III	IV	V
Mois				—	—	—	2.1
Novembre 1948				—	—	—	23.3
Février 1949				7.8	6.6	18.9	20.0
Mars 1949				21.1	67.3	5.9	1.9

f) Vigo.				Poids des testicules en grammes			
Taille	Févr.	Mars	Avril	Mai	Juin	Oct.	Nov.
110	—	—	—	—	—	—	—
115	0.012	0.039	—	—	—	—	—
120	0.286	0.199	0.011	—	—	—	0.042
125	0.491	0.294	0.023	—	—	0.057	0.090
130	0.453	0.287	0.069	—	—	0.361	0.347
135	0.546	0.346	0.083	0.083	—	0.045	0.381
140	0.822	0.275	0.141	0.242	—	0.057	0.444
145	1.175	1.475	0.131	0.351	0.856	0.127	0.655
150	1.245	1.801	0.288	0.569	1.255	0.180	0.670
155	1.066	1.374	—	1.212	0.983	0.175	0.661
160	—	1.650	—	1.126	1.285	0.169	1.310
165	1.581	1.104	—	2.810	1.654	—	0.151
170	—	2.370	—	—	1.839	—	1.551
175	1.874	1.169	—	—	1.889	—	1.418
180	1.525	0.780	—	—	2.627	—	1.701
185	—	—	—	—	3.513	—	—
190	—	—	—	—	—	—	—
195	—	—	—	—	—	—	—
200	—	—	—	—	—	2.429	—

Poids des ovaires en grammes				Poids des ovaires en grammes			
Févr.	Mars	Avril	Mai	Juin	Oct.	Nov.	Déc.
0.020	—	—	—	—	—	—	—
—	0.027	0.035	—	—	—	0.056	—
0.343	0.152	0.036	—	—	0.015	0.270	0.293
0.439	0.032	0.084	—	—	0.006	0.186	0.387
0.280	0.180	0.082	0.068	—	0.035	0.242	0.309
0.625	0.496	0.104	0.174	—	0.051	0.356	0.831
1.049	0.753	0.092	0.203	—	0.078	0.318	0.777
0.589	1.567	0.050	0.317	—	0.091	0.538	1.224
3.120	1.285	0.044	1.040	1.119	0.225	1.062	—
1.247	1.681	—	0.814	1.105	0.108	1.407	—
2.200	2.255	—	1.428	1.261	0.255	1.903	—
—	2.515	—	1.706	1.416	—	1.521	—
—	—	—	1.891	1.677	—	2.925	—
—	—	—	—	2.003	—	2.450	—
—	—	—	—	1.264	—	0.719	—
—	—	—	—	—	—	1.898	—
—	—	—	—	1.566	—	1.239	—
4.200	—	—	—	—	—	—	—

C. Vertèbres.

a) Côte Basque.								e) Vigo.								
Date	51	52	53	54	M ± FI	± σ		Date	Vertèbres				M ± FI	± σ		
13-VI-48	29	46	22	3	51.99±0.27	0.793		1949	49	50	51	52	53	N		
14-X-48	28	50	22	0	51.94±0.24	0.704		14-II	—	18	52	27	2	99	51.13±0.24	
24-III-49	26	52	22	0	51.96±0.23	0.691		24-II	4	10	49	30	—	93	51.13±0.27	
Total:	83	148	66	3	51.96±0.14	0.731		10-III	—	7	52	38	1	98	51.33±0.21	
								10-III	—	20	47	25	—	92	51.05±0.24	
b) Santander.								26-III	—	9	65	19	1	94	51.13±0.20	
Date	49	50	51	52	53	N	M ± FI	± σ	9-IV	—	16	62	18	—	96	51.02±0.20
1948	—	—	—	—	—	—	—	—	26-IV	—	17	60	17	—	94	51.00±0.21
13-X	—	2	15	74	13	104	51.94±0.19	0.585	11-V	—	15	63	18	1	97	51.05±0.21
2-XI	—	4	20	67	15	106	51.89±0.22	0.682	24-V	—	20	68	10	2	100	50.94±0.21
18-XI	—	2	21	77	5	105	51.81±0.18	0.536	15-VI	1	15	48	22	—	86	51.06±0.25
1949	—	—	—	—	—	—	—	—	30-VI	—	13	48	33	—	94	51.25±0.23
5-IV	—	—	14	78	13	105	51.99±0.17	0.507	13-IX	—	4	47	21	1	73	51.26±0.23
28-IV	—	4	23	71	7	105	51.77±0.20	0.621	11-X	—	2	47	26	—	75	51.32±0.20
9-VI	—	3	14	75	12	104	51.92±0.20	0.599	27-X	—	9	58	31	1	99	51.24±0.21
1-VII	1	17	32	54	1	105	51.35±0.26	0.792	16-XI	—	8	42	41	—	91	51.36±0.22
21-VII	2	6	21	71	5	105	51.68±0.24	0.736	29-XI	—	5	49	25	3	82	51.32±0.24
11-VIII	2	6	18	67	12	105	51.77±0.26	0.795	22-XII	—	2	37	22	2	63	51.38±0.26
19-X	1	5	26	60	11	103	51.73±0.25	0.752	Total	5	190	894	423	14	1526	51.16±0.06
Total:	6	49	204	694	94	1047	51.78±0.07	0.690								0.651

Tableau 2 C suite.

f) Malaga.							g) Baléares.				
Vert.	28-3	20-6	19-10	22-12	19-1	Total	Vert.	1948	1949		
	49	49	49	49	50			Nov.	Févr.	Mars	Total
50	6	3	5	2	1	17	50	2	3	2	7
51	64	59	53	50	61	287	51	41	35	31	107
52	30	38	42	27	38	175	52	50	43	19	112
53	—	—	—	1	—	1	53	1	9	1	11
N	100	100	100	80	100	480	N:	94	90	53	237
M	51.24	51.35	51.37	51.34	51.27	51.33	M:	51.53	51.64	51.36	51.54
Fl ±	0.18	0.18	0.19	0.21	0.17	0.08	Fl:	±0.19	±0.25	±0.29	±0.14
σ ±	0.549	0.536	0.577	0.546	0.503	0.545	σ:	±0.559	±0.704	±0.630	±0.633

D. Age.

a) Vigo.							
Classes (âge)		Classes (âge)					
Taille	0	I	II	III	Taille	0	I
105	2	—	—	—	170	1	34
110	10	—	—	—	175	—	34
115	18	1	—	—	180	3	25
120	56	6	—	—	185	—	10
125	66	48	—	—	190	—	1
130	129	97	—	—	200	—	1
135	122	110	—	—	205	—	2
140	129	119	—	—	215	—	3
145	120	109	—	—	220	—	2
150	79	74	1	—	225	—	2
155	34	62	1	—	230	—	1
160	30	67	6	—	235	—	2
165	11	36	1	—			

E. Engraissement.

a) Santander.					
Date	I	II	III	IV	
1948					
13-X	—	1	17	86	
2-XI	—	1	21	84	
18-XI	—	—	9	96	
1949					
5-IV	—	101	4	—	
28-IV	81	23	1	—	
9-VI	—	83	21	—	
1-VII	—	1	102	2	
21-VII	—	—	23	82	
11-VIII	—	2	22	81	
19-X	7	11	40	45	

d'un an et demi et de deux ans; dans le troisième lot (taille moyenne 14.8 cm.) dominent les sardines d'un an.

Les poids moyens sont normaux; comme d'habitude ils sont plus grands en été qu'en hiver.

Sexualité et engraissement.

Le nombre des femelles surpasse celui des mâles; pourcentage respectif 54% ♀ et 46% ♂. La taille moyenne des mâles n'est pas toujours plus petite que celle des femelles. (Tableau 2 Ba).

Nos observations permettent de soupçonner que la maturation sexuelle est ralentie pendant l'été et l'automne et que la ponte des sardines d'un an se fait tardivement, à la fin du printemps. De même, elles mettent en évidence le

rapport inverse entre la graisse viscérale et le degré de maturité des gonades.

Vertèbres.

La formule vertébrale déduite de notre matériel est $51,96 \pm 0,14$ ($N=300$); les écarts entre les trois échantillons sont très faibles (Tableau 2 Ca). Nous rappelons, pour comparaison, les quelques données déjà acquises dans la région: 1932 = $51,45 \pm 0,26$ ($N=174$); 1933 = $52,60 \pm 0,43$ ($N=48$); 1944 = $51,94 \pm 0,07$ ($N=795$).

J. M. NAVAZ et F. NAVARRO.

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Côte de Santander.

(Octobre 1948—Octobre 1949).

La pêche de la sardine dans la région de Santander restant toujours en déclin, c'est avec de la peine que nous avons pu opérer au marché: 10 prélèvements seulement ont pu être effectués au cours de l'année. Ces 10 échantillons proviennent de pêches à la rogue, au filet tournant («cerco»).

Nos observations ont porté principalement sur les points suivants: Répartition des tailles, poids, sexe et maturité sexuelle, engraissement et formule vertébrale. Comme le nombre des sardines dans les échantillons est 100 environ (103 à 106), il devient superflu d'en donner des valeurs en pourcentage.

Répartition des tailles.

La longueur totale, mesurée au millimètre, a été ramenée au demi-centimètre le plus proche pour former les classes de tailles. La composition des échantillons est indiquée dans le Tableau 2 Ab. La dispersion est grande et la taille moyenne des lots est très variable, de 14.5 à 19.4 cm. La classe de 16 cm. est prédominante dans l'ensemble, mais nous pensons qu'un autre échantillonnage du même volume aurait pu donner une courbe des fréquences substantiellement différente.

Les sardines ont été pesées individuellement, exception faite de quelques exemplaires. Nous rapportons au Tableau 2 Ac leurs poids moyens chaque mois et au total.

Sexe et maturité sexuelle.

Il est un fait déjà bien établi: la prédominance des sardines femelles sur les mâles; cette circonstance est parfois remarquablement accentuée dans la côte nord d'Espagne. Les nouvelles observations à Santander sur 1,047 poissons signalent 631 femelles, 394 mâles et 22 jeunes à sexe indéterminable (pourcentage de 60.3% 37.5% et 2.1% respectivement). Il est particulièrement intéressant de signaler que dans l'échantillon du 28 Avril, composé de sardines mûres, l'on trouve 102 femelles pour trois mâles.

D'autre part, la taille moyenne des femelles est généralement un peu plus grande que celle des mâles du même échantillon (Tableau 2 Bb).

L'évolution de la maturité sexuelle, telle qu'elle est déterminée d'après l'échelle empirique de LE GALL et la pesée des gonades, est

exposée au Tableau 2 Bc. On voit que la ponte n'a commencé en 1949 qu'à la mi-Juin, ainsi qu'elle a été rapidement terminée. Malheureusement, la pauvreté du matériel risque de fausser les faits.

En ce qui concerne le poids total des glandes, il faut rappeler la diversité des tailles moyennes des lots et celle des mâles et des femelles composant les échantillons.

Engraissement.

L'évolution de la graisse mésentérique, attestée par les chiffres du Tableau 2 Ea, est complètement inverse de celle de la maturation génitale.

Moyenne vertébrale.

Les fréquences et les moyennes pour chaque échantillon sont données au Tableau 2 Cb. A remarquer que la valeur moyenne pour l'ensemble (51.78) est plus petite que celle obtenue dans l'hiver 1947—1948 (51.90 ± 0.13 , $N = 429$), à son tour inférieure à celle de la période 1940—1944 (52.18 ± 0.05 , $N = 2,290$). D'autre part, la valeur moyenne de l'échantillon du premier Juillet est particulièrement faible, bien que le mode se maintienne à 52 vertèbres.

Des fluctuations fortes et soudaines de la formule vertébrale ont été déjà signalées chez la sardine de Santander, mais nous ne pouvons pas, pour l'instant, les interpréter.

R. FERNANDEZ et F. NAVARRO.

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Vigo en 1949.

Au cours de l'année, 17 échantillons (1748 sardines) provenant des pêches au filet tournant à l'alentour des Cies, îlots placés à l'embouchure de la «ria» de Vigo, ont été étudiées. Cependant, l'échantillon numéro 4 provient de la ria de Pontevedra. L'absence d'observations en Janvier, Juillet et Août rend incomplète, malheureusement, cette série annuelle.

Une vingtaine de grandes sardines, dont nous parlerons plus tard, sont mises hors de série.

Taille.

Les tailles, mesurées au millimètre près, sont ramenées au demi-centimètre *inférieur*. Les valeurs moyennes et extrêmes à chaque date sont portées au Tableau 2 Ad. Leur répartition mensuelle et annuelle est exprimée dans le Tableau 2 Ae. La courbe totale des fréquences traduit fidèlement ce qu'est la population actuelle en Galice: une population dont les sardines âgées de trois ans sont absentes, et rares celles de deux ans. Les sardines d'une taille comprise entre 12.5 et 15.5 cm. forment les 71% du total.

Poids.

Les sardines ont été pesées individuellement entières et vidées, c'est-à-dire éviscérées. Les poids moyens pour les diverses classes de taille figurent dans le Tableau 2 Af.

Caractères sexuels.

Le nombre des mâles (830) est bien supérieur à celui des femelles (716), circonstance déjà constatée à Vigo; la proportion est très variable selon les échantillons, Tableau 2 Bd.

Les petites sardines à sexe imprécis sont abondantes ($N = 202$).

La taille des femelles est en général plus forte que celle des mâles du même échantillon. La différence devient plus expressive dans le Tableau 2 Be.

L'observation empirique permet de reconnaître l'évolution de la maturation génitale (Tableau 2 Bd); la pesée des gonades complète cette observation (Tableau 2 Bf), bien que soit regrettable l'absence de données en Janvier et en Juillet.

Bien que la période principale de ponte semble être terminée au commencement d'Avril, des bancs de sardines assez mûres sont apparus à nouveau en Mai-Juin, signalant une période secondaire de ponte tardive dont la durée et l'intensité restent à préciser. Les gonades restent en repos jusqu'en Octobre; la maturation s'accélère ensuite.

Répartition d'après l'âge.

Que ce soient la ponte ou la température qui déterminent la formation des «anneaux d'hiver» sur l'écaïlle, la coïncidence de ces deux facteurs et la prédominance du matériel recueilli en hiver et au printemps expliquent la très faible différence constatée entre la taille moyenne des sardines de la classe 0 et celle des sardines de la classe I (Tableau

2 Da). Les classes II et III sont très pauvrement représentées.

Formule vertébrale.

Bien que la moyenne vertébrale obtenue en 1949 (51.17) soit à peu près égale à celle de la période Novembre 1947—Février 1948 (51.19 ± 0.06 , $N = 1884$), il est très intéressant de constater une certaine «tendance» vers l'augmentation de la moyenne dans les sept derniers échantillons (Tableau 2 Cc).

Peut-être y a-t-il une réelle différence à ce sujet entre la génération de 1947—1948 et celle de 1948—1949.

Nourriture.

L'examen de la nourriture a été très soigné: (pesée du contenu et proportion quantitative des composants), mais, à présent, nous nous limiterons à confirmer que l'alimentation de la sardine n'est pas un processus sélectif, mais qu'elle absorbe tout sans discrimination. Parfois, pendant la saison de pollinisation des conifères, nous avons trouvé les sardines gavées de pollen de pin.

Sardines de grande taille.

Nous avons eu l'occasion d'étudier en Janvier une douzaine de sardines mesurant 193 à 230 mm. pêchées, assez fréquemment dans le port même, à l'hameçon (!). Assez mûres (IV, 6 en moyenne) presque toutes femelles (11 ♀ pour un mâle), elles avaient l'estomac plein.

Un autre groupe de huit sardines nous est parvenu en Décembre, envoyées par les usines de conserves à titre d'exemplaires exceptionnels depuis longtemps. Taille, 219—232 mm.; maturité moyenne plus basse qu'en Janvier. Ces grandes sardines étaient âgées de deux ou trois ans (Tableau 2 Da).

M. OLIVER.

Portugal, 1947/49.

Le résultat du dénombrement des vertèbres de 6,855 sardines (56 échantillons) pêchées dans le voisinage de Leixões (près de Porto), Lisbonne, Portimão et Olhão, entre les mois de Novembre 1947 et Mai 1949, est donné dans le Tableau 2 Cd. Les moyennes vertébrales des échantillons montrent une stabilité assez marquée de 51.1—51.2; toutefois il semble y avoir aussi tendance à une légère diminution du nord vers le sud. Ces moyennes

sont en général inférieures à celles obtenues en 1921—22 et 1930—31 (51.3—51.4), mais du même ordre que celles déterminées, d'ailleurs avec un très petit nombre d'exemplaires, en 1925 et 1927 (Rapp. et Proc. Verb., Vol. LXXXIV, pp. 34—35. 1933).

A la suite des observations de MURAT (1935) et surtout de NAVARRO et NAVAZ (1946), nous avons aussi préparé des tableaux à double entrée indiquant le nombre de vertèbres caudales et pré-caudales (celles-ci comprenant aussi les vertèbres ayant l'arc hémal incomplet et non fermé) des sardines d'une partie des échantillons récoltés à Leixões, Lisbonne et Portimão (2 Ce). Nous espérons pouvoir y ajouter plus tard quelques remarques sur ces résultats préliminaires.

Un troisième tableau (2 Ag), résume la distribution des tailles observées dans l'ensemble des échantillons de sardines de Lisbonne étudiés pendant les hivers de 1947/48 et 1948/49 (mois de Novembre au mois de Mars), classés selon l'âge montré par les écailles. Il faut remarquer que, en raison des difficultés dans la récolte des échantillons, ceux-ci ne peuvent pas être considérés comme véritablement représentatifs des stocks, mais ils peuvent néanmoins donner quelques indications grossières sur leur constitution. En particulier, les exemplaires les plus petits de 1948/49, qui d'ailleurs ont été recherchés expressément dans des conditions un peu diverses de celles qui sont usuelles dans les apports des bateaux de pêche, montrent la grande amplitude de la taille atteinte à l'occasion du premier hiver dans la vie de la sardine de la région.

A. M. RAMALHO et collaborateurs.

La Reproduction de la Sardine dans la zone côtière du Maroc (1948).

La ponte de la sardine Marocaine, tout en s'adaptant aux conditions hydrologiques particulières à chaque année, semble présenter dans sa géographie et son calendrier des traits généraux constants.

Débutant en automne ou en hiver, maxima au printemps, elle finit en été.

Liée aux conditions de température du milieu marin, elle groupe les reproducteurs en 2 zones, l'une septentrionale, l'autre méridionale, dont l'importance et l'étendue varient avec la saison.

La température optima se place entre 16 et 20° C. (18° en moyenne); hors de ces limites

la ponte ne pourrait se faire en conditions satisfaisantes.

Ce caractère oecologique différencie plus nettement encore que les caractères anatomiques la sardine de race Africaine des races Européennes qui se reproduisent à des températures beaucoup plus basses.

Il est remarquable aussi que le secteur central Marocain (Safi) qui possède le peuplement le plus riche en sardines adultes soit éloigné de plusieurs centaines de kilomètres des aires de pontes. Occupé toute l'année par des eaux froides (16°) il est abandonné par les reproducteurs au fur et à mesure de leur évolution sexuelle; ils y reviennent après la ponte. Ainsi se trouve démontrée la réalité de migrations périodiques et de grande amplitude; l'absence d'œufs de sardines dans le plancton de cette zone est un sûr garant de leur existence.

JEAN FURNESTIN et MARIE-LOUISE FAURE.

La Nourriture de la Sardine le long des Côtes du Maroc.

Nous avons examiné une petite collection d'échantillons d'estomacs de sardines du Maroc pour en étudier la nourriture. Le volume moyen par estomac varie entre 0.13 et 0.71 cm³. La plus grande partie de la nourriture est fréquemment constituée par une «matière indéterminable» représentant vraisemblablement des détritits.

Le zooplancton domine en automne et se compose en majorité de copépodes; mais il y a aussi eu un assez grand nombre de cladocères, de Sagitta, de larves de décapodes et de cirripèdes.

Un seul échantillon (Casablanca — Octobre) présente du phytoplancton déterminable et dominant et son contenu stomacal est très différent de celui des autres échantillons examinés. Il est en effet presque exclusivement constitué par un très grand nombre de péridiniens surtout *Goniaulax polyedra* et de kystes de la même espèce accompagnés cependant d'un assez grand nombre de diverses espèces des genres, *Prorocentrum*, *Dinophysis* et *Perrinitium*.

POUL JESPERSEN.

Malaga.

Au cours des dix dernières années ont été étudiées au laboratoire de Malaga 122 échantillons de sardines, dont le nombre total d'individus surpasse de 12,200. Les publications sig-

nalées à la fin de cette note embrassent jusqu'à la mi-Mars de 1949. Depuis cette date jusqu'en Janvier 1950, cinq échantillons ont été étudiés; bien que les résultats obtenus n'apportent aucune nouveauté transcendante il convient d'en rendre compte.

Taille.

La répartition des tailles dans les échantillons (Tableau 2 Ah) révèle que le prélèvement du matériel fut souvent incorrect, ce qui fausse la courbe totale des fréquences. Les sardines des trois premiers lots sont âgées d'un an à un an et demi; elles proviennent de pontes tardives (celles du 20 Juin). Par contre, dans les deux derniers échantillons, sont mélangés les poissons d'un et de deux ans, avec quelques-uns plus âgés dans le prélèvement de Décembre.

Dans l'ensemble, la dispersion des tailles est grande (de 116 à 207 mm.); la taille moyenne est de 143 millimètres.

Caractères sexuels et engraissement.

La disproportion numérique entre les mâles et les femelles vient aboutir aux pourcentages de 39.3 ♂ et 60.7 ♀ dans un total de 392 sardines. Le sexe de la plupart des petites sardines étudiées en Juin était indéterminable.

La supériorité de la taille de l'un ou de l'autre sexe est alternative dans les échantillons étudiés et les valeurs moyennes absolues sont à peu près égales: 145.8 mm. pour les femelles et 145.5 pour les mâles.

On voit — Tableau 2 Bg — que la ponte de la saison 1948—49 était virtuellement finie à la fin de Mars, les gonades restant au repos jusqu'en Octobre. Dans l'échantillon de Décembre, très hétérogène, tous les stades de maturité sont représentés; un mois plus tard les deux tiers des poissons se sont déjà vidés de leurs produits sexuels.

Les chiffres empiriques de l'engraissement viscéral, bien que confus, attestent un processus inverse de la maturation sexuelle:

Date	Stades (%)			
	I	II	III	IV
20/8-49	—	—	100	—
19/10	—	—	—	100
22/12	86.2	—	12.5	1.3
19/1-50	62	8	23	7

Vertèbres.

La formule vertébrale de chaque lot et de l'ensemble est donnée au Tableau 2 Cf. Les chiffres (compte tenu de la valeur de FI)

traduisent l'homogénéité de la population. La comparaison des résultats acquis à Malaga depuis 1940 est particulièrement intéressante:

Période 1940—1946	51.31 ± 0.02	N = 8297
Hiver 1947—1948	51.16 ± 0.05	N = 1597
Août 1948—Mars 1949	51.21 ± 0.06	N = 861
Mars 1949—Janvier 1950	51.33 ± 0.08	N = 480

Si nous considérons comme valeur normale celle de la période 1940—1946 (puisque sa durée et le volume du matériel suffisent à compenser les fluctuations de la formule chez les générations ou classes successives), nous pouvons dire que la situation est à présent «normalisée» après la disparition des classes à moyenne vertébrale remarquablement basse; c'est-à-dire celle de l'hiver 1944—1945 (51.11 ± 0.08) et celle de l'hiver 1946—1947 (51.15 d'environ).

EMMA BARDÁN et F. NAVARRO.

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F. NAVARRO, 1944, 1946, 1948, voir p. 61.

La Ponte à la Côte est d'Espagne (Hiver 1948—1949).

D'après les observations poursuivies du début d'Octobre 1948 à mi-Février 1949, la ponte de la sardine dans la région Vinaroz-Castellon-Columbretes (au sud de l'embouchure de l'Ebre) a eu lieu pendant la période de Novembre à Février et surtout en Décembre et en Janvier.

L'étude systématique du plancton décèle la présence d'œufs dans la zone signalée dans la carte ci-jointe et pas ailleurs.

Les femelles en état de maturité parfaite (ovaires gonflés, grenus, translucides, mous, se désagrégeant en ouvrant l'abdomen) ne furent trouvées qu'en très petit nombre (50 environ parmi les trois mille sardines examinées) et seulement autour des îlots Columbretes (voir carte).

Ces femelles en fraie ont été toujours pêchées au chalut, par 70—150 brasses de profondeur, au mois de Décembre et le 22 Janvier. Par exception, les 5 et 6 Décembre, deux pêches au filet tournant (pêche «au feu») donnèrent aussi quelques sardines dont la ponte était toute récente. Il faut rappeler que l'examen de sardines provenant de pêches sur le fond ne fut commencé qu'à partir du 2 Décembre.

Ces femelles «réellement» mûres sont une trouvaille dont la rareté a été déjà signalée par CLARK, Fish Bull. California, No. 42, 1934, et autres auteurs. Il se pourrait que le processus de la maturation aboutit à une soudaine et rapide «crise de fraie», comportant un bref déplacement du poisson de son milieu et modification de ses habitudes normales, et tout se passe comme si la population de la région se rassemblait près des Columbretes pour y accomplir la ponte.

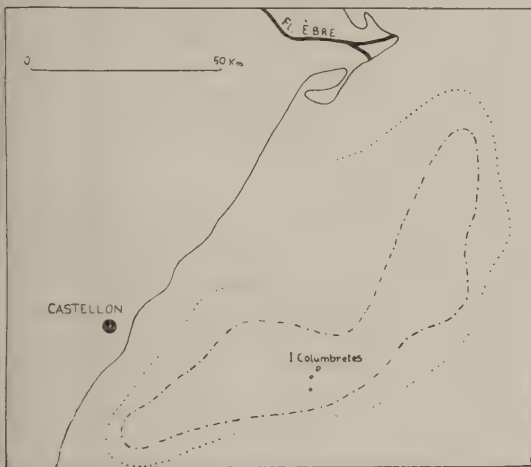


Figure 9. Aire de ponte de la Sardine.

Courbe en traits et points: Zone de pêche au chalut de femelles bien mûres.

Courbe pointillée: Aire où des œufs ont été repérés.

Nous avons constaté pendant la période de ponte la prédominance des mâles dans les échantillons pêchés au filet tournant, phénomène accentué en Décembre.

La fécondité absolue des cinquantes femelles mûres a été établie par dénombrement des ovules. Un tiers seulement des ovules remplissant l'ovaire parvient à maturité; un autre tiers disparaît par histolyse; le reste, représenté par des cellules qui n'ont pas encore initié leur vitellogénèse, demeure en réserve pour l'année suivante.

B. ANDREU.

Aux Baléares (Hiver 1948—1949).

Au cours de l'hiver 1948—49 ont été étudiés à Palma de Majorque neuf petits échantillons, dont trois en Novembre (provenant de pêches «au feu»), six en Février et en Mars, pêchés au chalut. Ces derniers lots étaient des mélanges en proportions inégales d'allaches (*Sardinella aurita* C. V.) et de sardines.

Ce matériel bien que peu abondant, est intéressant à comparer avec celui étudié au cours de l'hiver 1947—1948. En outre, cette pêche de la sardine en Janvier-Mars à l'aide de filets trainants pose des problèmes concernant le comportement de l'espèce lors de la période de ponte.

Répartition des tailles.

Bien que les filets de pêche ne soient pas sélectifs, le petit nombre d'individus examinés ne permet pas de considérer l'échantillon comme représentatif de la composition de la population. Cependant, les valeurs totales du Tableau 2 Ai traduisent une courbe de distribution assez régulière.

Dans son ensemble, le matériel prélevé paraît composé de sardines de deux ans, groupées autour de la taille modale, 17.5 cm., avec comme valeurs extrêmes 15.0 et 21.5 cm. Cette représentation est différente de celle obtenue au cours de l'hiver 1947—1948, où 98% des sardines étudiées, âgées d'un an seulement, mesuraient en moyenne 14.5 cm.

Dans la courbe des fréquences un sommet secondaire à la taille de 20 cm. traduit sans doute la présence de sardines de trois ans.

Sexe et maturation sexuelle.

On déduit du Tableau 2 Bh que la ponte a dû commencer en Décembre et se poursuivre jusqu'à Février. Elle était finie virtuellement en Mars.

Pour un total de 288 sardines, 190 étaient des femelles (soit 66%) et 98 seulement sont mâles (34%). Cette prédominance des femelles a lieu justement pendant la période de pleine maturité:

	Novembre	Février	Mars
Femelles %...	78.8	52.2	53.8
Males %.....	21.2	47.8	46.2

Réplétion stomacale.

En Février-Mars, en coïncidence du minimum thermique de l'eau et des autres conditions défavorables qui correspondent au soi-disant hivernage de ces poissons, nous avons précisé sur toutes les sardines, le stade de réplétion de l'estomac selon l'échelle empirique habituellement utilisée. Les fréquences observées sont les suivantes, en pourcentage:

Date	Stades			
	I	II	III	IV
9 Février.....	—	6	90	4
12 »	—	—	100	—
23 »	—	—	—	100
1 et 31 Mars.	—	—	—	100

L'arrêt ou le ralentissement hivernal de la croissance de la sardine — s'il existe — n'est pas réellement imputable à un déficit alimentaire.

Vertèbres.

Les valeurs successives de la formule vertébrale pour les divers mois et pour l'ensemble sont exposées au Tableau 2 Cg. Pour comparaison, nous rappelons les chiffres trouvés par nous à Majorque pendant la période 1940—1943 (51.58 ± 0.08 , $N = 867$) et en hiver 1947—1948 (51.51 ± 0.11 , $N = 315$). En Mahon (Minorque) on a trouvé en 1946: 51.41 ± 0.17 ($N = 240$).

THÉRÈSE VALLS, M. MASSUTI et F. NAVARRO.

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- - - 1944, 1946, 1948, voir p. 61.

Sardinelle (*Sardinella aurita* C. V.).

La Sardinelle ou Allache des Baléares. (Juillet 1948—Mai 1949).

La provenance des lots de cette série étudiée au laboratoire de Palma de Majorque n'est pas toujours bien fixée. Vraisemblablement, les prélèvements opérés en été et en automne ont porté sur des pêches «au feu»; ceux d'hiver (Janvier-Mars) proviennent de pêches

Tableau 3. Fréquence des tailles.

Taille, mm.	N	‰	Taille, mm.	N	‰
115	1	1.25	215	41	51.25
120	3	3.75	220	43	53.75
125	2	2.50	225	36	45.00
130	1	1.25	230	39	48.75
135	1	1.25	235	31	38.75
140	2	2.50	240	25	31.25
145	3	3.75	245	23	28.75
150	5	6.25	250	20	25.00
155	3	3.75	255	15	18.75
160	4	5.00	260	17	21.25
165	12	15.00	265	8	10.00
170	17	21.25	270	3	3.75
175	22	27.50	275	1	1.25
180	45	56.25	280	2	2.50
185	52	65.00	285	1	1.25
190	56	70.00	290	2	2.50
195	68	85.00			
200	73	91.25			
205	66	82.50			
210	57	71.25			

N: 800
Moy. = 209 mm.

au chalut, tandis que les échantillons du printemps ont été pêchés au filet dérivant, (engin tombé en désuétude à Majorque).

Taille.

Par sa forte taille le matériel actuel fait contraste avec celui étudié en hiver 1947—1948, composé en majeure partie (91%) par des jeunes sardinelles ne dépassant pas 14 centimètres.

La taille varie entre 11.5 et 29 cm.; valeur moyenne = 20.9. Les fréquences pour 1,000 sont indiquées dans le Tableau 3, où les irrégularités présentes au-dessous de la valeur moyenne révèlent un mélange d'individus âgés de deux et trois ans et plus âgés.

Sexe et maturité.

Le Tableau 4 montre que le stade III de maturité domine en Juillet et passe rapidement à V en Août. La ponte a eu lieu sans doute en Septembre et Octobre, période sans observations. La plupart des poissons sont au stade II en Décembre; ensuite, l'évolution de la maturité se poursuit très lentement jusqu'en Mai.

Tableau 4.
Fréquence des stades de maturité (%).

Mois	Stades de maturité					
1948—1949	II	III	IV	V	VI	VII
Juillet.....	7.0	42.0	25.0	19.0	7.0	—
Août.....	7.5	26.7	25.1	32.1	8.0	0.6
Décembre.....	81.6	18.4	—	—	—	—
Janvier.....	87.8	12.3	—	—	—	—
Février.....	55.1	26.5	16.3	2.1	—	—
Mars.....	53.0	38.6	8.4	—	—	—
Avril.....	43.0	52.0	4.0	1.0	—	—
Mai.....	42.0	46.0	10.0	2.0	—	—

Sur un total de 719 poissons examinés (après avoir écarté les individus détériorés ou de sexe imprécis), les femelles prédominent (52.3%). Par contre, la taille moyenne des deux sexes est égale: 21.3 centimètres.

Engraissement et réplétion stomacale.

L'allache est un poisson maigre à croissance rapide, à graisse viscérale peu abondante. En conséquence, l'échelle empirique d'engraisement utilisée pour la sardine et le hareng est peut-être fictive pour ce poisson. La fréquence des divers stades est indiquée ci-dessous en pourcentages:

Mois	Stades, %			
	I	II	III	IV
Juillet 1948....	63	31	6	—
Août.....	57	36	7	—
Février 1949...	62	31	7	—
Mars.....	59	37	3	1
Avril.....	13	68	19	—
Mai.....	22	68	10	—

De l'examen de la réplétion stomacale, il semble se déduire que l'été est une période à déficit alimentaire; la situation se montre très améliorée en Février et elle devient optimum pour les trois mois suivants. La fréquence des divers degrés de réplétion est exposée dans la suite en pourcentage:

Mois	Stades, %			
	I	II	III	IV
Juillet 1948....	24	56	10	—
Août.....	48	48	4	—
Février 1949...	—	1	38	61
Mars.....	—	—	—	100
Avril.....	—	—	—	100
Mai.....	—	—	—	100

Formulé vertébrale.

Les données relatives aux divers mois et à l'ensemble des échantillons examinés sont exposées dans le Tableau 5.

Tableau 5. Formule vertébrale.

Mois	Vertèbres					N	M ± FI	± σ
	46	47	48	49	50			
1948-1949	46	47	48	49	50	N	M ± FI	± σ
Juillet....	2	14	66	9	1	92	47.92 ± 0.21	0.612
Août.....	6	24	135	13	—	178	47.87 ± 0.14	0.571
Octobre..	—	7	26	4	—	37	47.92 ± 0.29	0.529
Décembre	1	5	76	14	—	96	48.07 ± 0.17	0.484
Janvier..	—	2	47	2	—	51	48.00 ± 0.13	0.280
Février...	—	10	45	8	—	63	47.97 ± 0.23	0.533
Mars.....	1	8	75	16	—	100	48.06 ± 0.28	0.525
Avril.....	—	9	76	16	—	101	48.07 ± 0.16	0.492
Mai.....	—	10	32	7	—	49	47.94 ± 0.28	0.585
Total:....	10	89	578	89	1	767	47.98 ± 0.07	0.537

Il semble bien intéressant de constater que la «tendance» vers une diminution de la valeur vertébrale moyenne s'est nettement maintenue au cours des vingt dernières années. La formule établie par nous en 1932 était de 48.15 ± 0.07 (N = 605); en hiver 1947—1948, elle tombe à 48.04 ± 0.10 (N = 493) et les chiffres actuels sont 47.98 ± 0.07 (N = 767).

M. MASSUTI, TH. VALLS et F. NAVARRO.

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S. aurita dans les mers Tunisiennes.

Le plancton recueilli au cours de la campagne du «Président Théodore Tissier» dans les mers Tunisiennes (Juin-Juillet 1949) montre une abondance notable d'œufs et de larves de *Sardinella aurita* C. V. dans certaines récoltes.

On sait, par ailleurs, que de petits poissons, dénommés «ouzeufs», font chaque année leur apparition, en Septembre et Octobre, près de la côte, dans la région de Djerba et du Golfe de Gabès.

Selon l'ouvrage de FACE et PONZEVEA mis à jour par BOURGE «Les Pêches Maritimes de la Tunisie» (1908) il s'agirait là de la melette, dont la taille ne dépasse par 10 cm. Les auteurs signalent encore que les captures sont abondantes en Septembre et Octobre.

D'après GRUVEL («L'Industrie des Pêches sur les côtes tunisiennes» 1936) on aurait affaire à la melette phalérique: *Meletta phalerica* RONDELET qui vient ainsi à la côte en Septembre et Octobre.

Cette détermination, non plus que celle de *Clupea sprattus* qui lui est synonyme, ne doit pas être retenue.

Les arguments suivants autorisent cette affirmation:

1-Caractères anatomiques:

a) position de la dorsale plus rapprochée ici de l'extrémité du museau que de la racine de la caudale;

b) insertion de la ventrale en arrière de celle de la dorsale;

c) nombre de rayons des nageoires et en particulier nombre remarquablement constant (= 9) des rayons de la ventrale;

d) teinte noirâtre de la chambre branchiale.

2-Caractères physiologiques:

Il n'est jamais trouvé d'individus présentant des glandes sexuelles formées. Tous les sujets sont des immatures. Leur taille ne dépasse guère 7 cm. Les poids s'étagent entre 0.2 et 2 grammes. Ce sont là, de toute évidence des stades jeunes d'une espèce de plus grande taille.

En fait, il s'agit simplement des alevins de *Sardinella aurita* C. V. la sardinelle ou allache commune.

Il ressort de ces observations:

a) que *Sardinella aurita* C.V. fraie au large de la côte orientale de la Tunisie (région nord) et que sa ponte commence dès la première quinzaine de Juillet;

b) que les larves sont pélagiques et effectuent une migration vers le sud;

c) que les jeunes alevins, mesurant alors 3 ou 4 centimètres, se rapprochent du rivage dès que la température de l'eau se refroidit (Septembre-Octobre);

d) qu'ils effectuent dans la région du Golfe de Gabes et les parages de l'île Djerba un séjour au cours duquel leur taille peut atteindre 6 à 7 centimètres.

Après quoi, ils gagnent la haute mer.

Mme J. H. HELDT.

Anchois (*Engraulis encrasicolus* L.) de la Côte Basque (1948—1949).

Dans les publications signalées dans la bibliographie, nous avons rendu compte des résultats acquis sur le sujet jusqu'à mi-Février de 1948. Les études se sont poursuivies régulièrement au printemps de cette année, mais dès lors la rareté même l'absence de l'anchois au marché, accentuée en 1949, a rendu très difficile l'obtention de matériel.

De la fin de Février 1948 jusqu'à Mars 1949, nous avons prélevé dix échantillons, chacun de 100 poissons, pêchés au large de la côte Basque, de Bayonne aux approches de Santoña, tous au filet tournant, soit avec ou sans rogue.

Taille et poids.

La taille a été mesurée au millimètre près et ramenée au demi-centimètre le plus proche. Les valeurs extrêmes sont 9 et 18 cm., la moyenne absolue: 12.7 cm. La répartition des tailles dans chaque échantillon et pour l'ensemble est très irrégulière ou inexpressive (Tableau 6); cependant, elle vient confirmer que la taille moyenne de l'anchois Basque adulte se range entre 13 et 15 cm.

Les pesées ont été faites par classes de tailles dans huit des lots; les valeurs partielles et moyennes sont indiquées dans le Tableau 7. On constate, pour les groupes de taille bien représentés, une remarquable augmentation progressive du poids à partir de Février; mais cet accroissement n'est pas attribuable seulement à l'évolution des gonades. On notera aussi que le poids des anchois jeunes du présent matériel est plus petit qu'en hiver 1947—1948, tandis que celui des poissons adultes est plus grand.

Tableau 6.
Fréquence des tailles et taille moyenne.

Taille mm.	1948						1949				Total
	28-II	23-III	9-IV	5-V	4-VI	8-X	3-II	10-II	5-III	21-III	
90	—	—	—	—	—	6	1	—	—	—	7
95	—	—	—	—	—	29	10	—	3	—	42
100	—	—	—	—	2	42	10	—	34	—	88
105	—	—	—	—	9	14	13	—	35	—	71
110	1	—	—	—	21	4	12	4	23	—	65
115	1	4	—	—	21	5	23	18	5	—	77
120	1	12	—	—	16	—	13	26	—	—	68
125	1	21	1	—	17	—	7	17	—	—	64
130	10	20	6	1	11	—	7	15	—	16	86
135	13	13	11	8	2	—	4	14	—	28	93
140	11	16	12	17	—	—	—	2	—	30	88
145	13	4	24	21	1	—	—	4	—	18	85
150	15	3	13	26	—	—	—	—	—	6	63
155	15	4	16	9	—	—	—	—	—	1	45
160	8	1	10	13	—	—	—	—	—	1	33
165	10	2	3	3	—	—	—	—	—	—	18
170	1	—	2	1	—	—	—	—	—	—	4
175	—	—	1	1	—	—	—	—	—	—	2
180	—	—	1	—	—	—	—	—	—	—	1
Moy.	146	133	148	149	118	99	113	124	105	139	127

Tous les anchois de six de ces échantillons ont été pesés après éviscération. La comparaison du poids des poissons entiers et vidés (valeurs moyennes pour les classes de taille) est exposée dans le Tableau 8.

Sexualité.

La maturation sexuelle de l'anchois devient rapide en printemps et conduit à la ponte; celle-ci survient à la fin du printemps ou au début de l'été.

Tableau 7. Poids moyens (en grammes).

Taille mm.	1948						1949			Poids moyen	N
	28-II	23-III	9-IV	5-V	4-VI	8-X	10-II	21-III			
90	—	—	—	—	—	3.5	—	—	—	3.5	6
95	—	—	—	—	—	4.1	—	—	—	4.1	29
100	—	—	—	—	5.0	5.0	—	—	—	5.0	44
105	—	—	—	—	6.0	5.8	—	—	—	5.9	23
110	7.0	—	—	—	6.9	7.0	6.5	—	—	6.9	30
115	8.0	8.2	—	—	8.0	8.2	7.8	—	—	8.0	49
120	9.5	10.1	—	—	9.1	—	8.6	—	—	9.1	55
125	10.0	11.2	12.0	—	10.7	—	10.0	—	—	10.7	57
130	12.7	12.7	13.6	13.0	11.6	—	11.5	13.3	—	12.5	79
135	13.4	14.0	16.3	15.0	13.5	—	12.5	14.0	—	14.2	89
140	16.0	16.5	17.6	17.2	—	—	13.6	15.4	—	16.3	88
145	17.7	17.7	19.8	19.5	15.0	—	15.0	17.0	—	18.3	85
150	20.4	21.0	22.0	21.5	—	—	—	19.3	—	21.1	63
155	22.2	21.2	25.8	23.4	—	—	—	19.5	—	23.6	45
160	23.5	25.0	28.4	25.8	—	—	—	24.0	—	25.9	33
165	26.8	26.0	29.6	28.6	—	—	—	—	—	27.5	18
170	29.0	—	33.5	30.0	—	—	—	—	—	31.5	4
175	—	—	37.0	35.0	—	—	—	—	—	36.0	2
180	—	—	42.0	—	—	—	—	—	—	42.0	1

Tableau 8.
Poids moyens des poissons entiers (P)
et vidés (P').

Taille mm.	P	P'	Δ	N	Taille mm.	P	P'	Δ	N
90	3.5	3.2	0.3	6	140	16.9	15.0	1.9	56
95	4.1	3.8	0.3	29	145	18.7	16.8	1.9	63
100	5.0	4.4	0.6	44	150	21.3	18.8	2.5	57
105	5.9	5.1	0.8	23	155	23.7	21.4	2.3	44
110	6.9	6.2	0.7	26	160	26.0	23.1	2.9	32
115	8.1	7.4	0.7	31	165	27.5	24.4	3.1	18
120	9.5	8.6	0.9	29	170	31.5	27.7	3.8	4
125	11.0	9.9	1.1	40	175	36.0	31.5	4.5	2
130	12.6	11.2	1.4	48	180	42.0	37.0	5.0	1
135	14.8	13.3	1.5	47					

Nous avons observé qu'en fin Février 1948, le degré de maturité moyen était II. Un mois après, il devient III et il atteint IV pendant la première dizaine d'Avril. Au commencement de Juin, quelques anchois sont au stade V (en concret: 6% au stade III, 87% au stade IV et 7% au stade V). Enfin, au début de Juin, les exemplaires parviennent aux stades V et VI, ce qui montre un léger retard par rapport à l'évolution normale.

Le début du processus reste sans variations en 1949. Les anchois sont tous au degré I le 3 et le 10 Février; il y en a aux stades I et II le 5 Mars. Peu après, le 21 Mars, 57% des individus sont au stade III et le reste au stade IV.

Les femelles sont plus nombreuses que les mâles, leur pourcentage respectif pour 400 poissons étant 68.2 et 31.8. La disproportion devient excessive dans un échantillon (5 Mai 1948) où les femelles sont 95 pour 5 mâles.

La taille moyenne des sexes a été calculée dans trois lots avec des résultats fluctuants:

	5. V. 1948	4. VI. 1948	21. III. 1949
Femelles, cm. ...	14.9	11.7	14.0
Mâles, cm.	14.9	11.9	13.8

Vertébrés.

La formule vertébrale de la population est restée à peu près inaltérée au cours de l'année (Tableau 9). Celle de l'ensemble comparée

Tableau 9. Formule vertébrale.

Date	46	47	48	49	M ± FI	σ ±
28-II -48 ...	13	70	15	2	47.06 ± 0.20	0.597
23-III-48 ...	15	68	17	—	47.02 ± 0.19	0.565
9-IV -48 ...	15	68	16	1	47.03 ± 0.20	0.590
5-V -48 ...	8	72	19	1	47.13 ± 0.18	0.541
4-VI -48 ...	18	59	22	1	47.06 ± 0.22	0.660
8-X -48 ...	17	57	20	6	47.15 ± 0.26	0.766
3-II -49 ...	10	70	18	2	47.12 ± 0.20	0.587
10-II -49 ...	15	65	20	—	47.05 ± 0.20	0.589
21-III-49 ...	16	59	22	3	47.12 ± 0.23	0.696
Total:	127	588	169	16	47.08 ± 0.07	0.627

à nos précédentes observations à Saint-Sébastien semble parfaitement normale:

1944 (été)	47.07 ± 0.22	N = 128
1946—1947	47.09 ± 0.07	N = 1000
1947—48 (hiver)	47.20 ± 0.10	N = 500
1948—1949	47.08 ± 0.07	N = 900

J. M. NAVAZ et F. NAVARRO.

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La Reproduction de l'Anchois dans la Zone côtière du Maroc (1948).

La reproduction de l'anchois Marocain, comme celle de la sardine, peut s'étendre sur toute l'année.

Débutant en hiver ou au printemps suivant l'année et le lieu, elle est maxima en été et s'achève en automne.

Obéissant aux mêmes lois que la sardine, mais plus thermophile encore, l'anchois se reproduit dans les eaux de forte température (18°—22°). Aussi sa ponte s'effectue-t-elle au nord et au sud dans les secteurs les plus chauds de la zone côtière Marocaine et toujours hors du secteur central de température trop basse.

JEAN FURNESTIN et
MARIE-LOUISE FAURE.

Sardinella granigera (S. *granigera* C. V.)

Espèce nouvelle pour la Faune Ichthyologique Tunisienne,

La présence de *Sardinella granigera* C. V. n'est connue en Méditerranée que sur les côtes d'Egypte: Port-Saïd et Alexandrie (Cuvier & Valenciennes 1847 — FAGE 1929) et dans la région d'Oran (DIEUZEIDE 1933).

Sur les quelque 4,000 km. de développement de côte qui séparent des points extrêmes, l'espèce n'a encore jamais été signalée, et l'on connaît bien peu de chose sur la biologie de ce poisson.

Nous apportons à ce sujet quelques données nouvelles:

Répartition. — *Sardinella granigera* C. V. se rencontre dans le golfe de Tunis. Nous avons capturé au cours de l'année passée une soixantaine d'exemplaires, au filet, près de la côte, devant Carthage.

Epoques. — Les captures faites dans la région d'Oran eurent lieu (V. DIEUZEIDE) au début du printemps: fin Février-Mars. Nous avons également pris ce poisson vers cette même époque (1er Février), mais aussi et surtout en fin d'été — début d'automne — fin Juillet à fin Octobre — avec une plus grande abondance en Août.

Tailles. Les tailles des sujets s'échelonnaient entre 12.5 et 25 centimètres.

Ponte. Nous avons pu noter que les glandes sexuelles arrivent à maturité en Août ce qui situe la ponte pendant la seconde quinzaine de ce mois. On commence à rencontrer, dès les premiers jours de Septembre, des femelles dont les ovaires sont vidés.

H. HELDT.

SCOMBRIDÉS

Maquereau (*Scomber scombrus* LINNÉ).

Observations faites en 1949 sur sa Biologie.

Quelques observations faites sur les pêcheries de maquereaux en Mer Celtique et sur la côte sud de Bretagne apportent des documents précis sur la croissance de ce poisson.

I. Origine: Belle Ile entre la Pointe Taillefer et Kerdonis, à deux milles de la côte.

Date: 15 Février 1949.

Engin de pêche: Bolinche en surface.

Taille.

	Répartition %									
cm.	19	20	21	22	23	24	25	26		
Représentation %	3.0	4.5	13.6	21.7	21.7	12.1	3.0	4.5		
cm.	27	28	29	30	31	32	33	34	N	
Représentation %	—	—	4.5	3.0	1.5	1.5	3.0	3.0	66	

Deux groupes, nettement séparés, correspondant à des classes annuelles différentes apparaissent dans cet échantillonnage.

a) Groupe A = Classes modales 22—23 cm.

Moyenne = 22.491

Longueur moyenne = 22.991 cm.

b) Groupe B: en nombre insuffisant pour tirer une conclusion précise. Cependant, deux modes, correspondant vraisemblablement à deux classes annuelles se dessinent.

Mode 29 et Mode 33.

Les individus du groupe A sont des immatures, ceux du groupe II, des adultes en période de maturation sexuelle.

II. Origine: Plateau Continental Cote 46° 35' N. et 4° 50' W. Gr.

Date: 4 Mars 1949.

Engin de capture: Chalut par 320 m. de profondeur.

Taille.

	Répartition %							
cm.	32	33	34	35	36	37	38	
Représ...	0.3	0.6	0.4	2.2	7.4	14.4	20.4	
cm.	39	40	41	42	43	44	N	
Représ...	21.8	17.1	10.1	4.0	1.2	0.2	161	

Mode = 39, Moyenne = 38.67, Longueur moyenne = 39.17.

Individus âgés, en période de maturité sexuelle (Stade VI de HJORT).

Cette observation confirme l'apparition, dès la fin de Février et le début de Mars, des maquereaux les plus âgés sur les frayères de l'espèce.

III. Origine: Baie de Concarneau, à l'est de l'île aux Moutons.

Date: 16 Septembre 1949.

Engin de capture: Maquereaux pêchés en surface en même temps que des sardines au filet Bolinche.

Taille.

	16	17	18	19	20	21	22	N
cm.								
Représentation %	12	17.9	20.8	20.9	15.0	10.4	3.0	67
								Mode = 19
								Moyenne = 18.52
								Longueur moyenne = 19.02 cm.

Onze maquereaux de 32 à 36 cm. ont été capturés en même temps que les individus du groupe précédent nettement caractérisé.

Leur répartition

	32	33	34	35
cm.				
%	9.1	27.3	45.4	18.1
				Mode = 34
				Moyenne = 33.72
				Longueur moyenne = 34.22 cm.

montre la présence dans la même région de maquereaux adultes ayant récemment pondu (stade II — HJORT).

Considérations Générales.

Ces résultats, complétant les observations de CHEVEY et MORICE sur les pêcheries de la Baie du Mont-St-Michel, ainsi que celles de E. P. PRIOL et de nous-mêmes en différents autres points du littoral Breton, sur la présence, en quantités parfois très abondantes de

la mi-Juin à la fin de Septembre, de jeunes maquereaux de 7 à 11 centimètres, confirment l'opinion que nous avons déjà émise sur la croissance de ce poisson en fixant celle-ci

de 8 à 11 cm. à la fin de sa 1ère année d'existence	
de 18 à 21 » » » » » 2ème » »	
de 26 à 28 » » » » » 3ème » »	
de 30 à 32 » » » » » 4ème » »	
de 32 à 35 » » » » » 5ème » »	

et en situant la première maturité sexuelle au début de sa quatrième année d'existence, lorsque il a atteint et dépassé de 26 à 28 centimètres.

JEAN LE GALL.

THUNIDÉS

Thon Rouge (*Thunnus thynnus* L.).

Dans les parages de Saint Jean de Luz, en 1949.

Les statistiques Françaises concernant les apports de thons rouges (*Thunnus thynnus* L.) montrent que ceux-ci bien que se poursuivant à longueur d'année, s'intensifient chaque année au cours du mois d'Avril, passent par un maximum en Juin, Juillet et Août, diminuent ensuite pour s'effondrer dès la fin d'Octobre.

Mois	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Apports en Tonnes:	3	4	22	24	217	880	674	820	380	91	6	0.5

Cette pêche se pratique régulièrement dans la région de Saint Jean de Luz où apparaissent, dès la mi-Avril, les premiers thons rouges qui se maintiennent dans les mêmes parages jusqu'à la fin d'Octobre.

Les mensurations faites au débarquement en Juin et Juillet montrent, qu'à cette époque, les bancs sont constitués par des thons de 70 cm. à 125 cm., d'un poids de 4.5 kg. à 24 kg. (viscères enlevés).

La représentation proportionnelle d'après leur taille des individus observés est la suivante:

Taille: mesurée au cm. près du bout du museau au milieu de la ligne joignant les extrémités de la caudale.

Résultats rassemblés par groupes de 5 centimètres ramenés à la décimale ou à la demi-décimale inférieure.

Représentation %. Nombre d'individus mesurés: 133.

Taille en cm.	70	75	80	85	90	95
Représ. %...	4.5	14.3	4.5	3.7	14.4	18.0
Taille en cm.	100	105	110	115	120	125
Représ. %...	7.5	4.5	15.1	9.0	2.3	2.2

Corrélation taille/poids.

Poids moyen établi pour chaque groupe d'individus (en hectogrammes).

Groupes Taille:	70	75	80	85	90	95
Poids (Hectogr.).	48.6	56.2	66.6	101	102	125
Groupes Taille:	100	105	110	115	120	125
Poids (Hectogr.).	134	175	193	197	197	237

Ces chiffres montrent deux paliers successifs dans l'ascension du poids en fonction de la taille:

a) entre 85 et 95 cm.: poids moyen = 100 et 102 hgr.

b) entre 110 et 125 cm.: poids moyen = 193, 197, 197 hgr.

séparées par des zones d'augmentation relativement rapide du poids du poisson.

Ces résultats basés sur 133 exemplaires seulement demandent à être confirmés.

Observateurs: CASTAGNE et FAUVEL.

JEAN LE GALL.

Le Thon de la Côte Basque.

Sur la côte nord d'Espagne, Saint-Sébastien est l'un des principaux ports thoniers, bien que les quantités annuelles débarquées y sont très variables. La statistique pour les huit dernières années donne les chiffres ci-dessous; la moyenne annuelle est d'environ 180.5 tonnes:

1942 =	63.8 tonnes	1946 =	326.5 tonnes
1943 =	39.8 »	1947 =	93.9 »
1944 =	69.4 »	1948 =	91.6 »
1945 =	174.8 »	1949 =	585.4 »

Le haut rendement en 1949 est attribué à l'emploi d'appâts vivants, méthode de pêche essayée par les pêcheurs Basques en 1947, généralisée et perfectionnée dans la suite.

La pêche du thon est essentiellement saisonnière, le rendement des quatre mois (Mai-Août), excédant 90 pour 100 du total annuel. Les valeurs moyennes mensuelles pour les susdites huit années, exprimées en pourcentage du total sont les suivantes:

Janvier	0.0	Juillet	34.7
Février	0.0	Août	16.3
Mars	0.4	Septembre	2.8
Avril	3.2	Octobre	1.1
Mai	16.6	Novembre	0.2
Juin	21.0	Décembre	0.05

L'étude des scombridés de la côte Basque a été commencée au cours de l'été 1949, en

exécution des recommandations de la «Conférence du Thon», tenue à Malaga par le Comité Atlantique.

Dans les halles à poisson de Saint-Sébastien, 100 thons longs de 64 à 167 cm, ont été mesurés, pesés et vidés.

Les résultats obtenus sont les suivants:

La méthode de travail, les mensurations et les notations employées sont celles que HELDT et FRADE ont préconisé. Les longueurs ont été obtenues à l'aide d'un ruban métrique, sauf la hauteur maxima du corps, mesurée au compas.

Les valeurs moyennes suivantes ont été obtenues:

$$N = 100.$$

	Moy.
L_5 du museau au centre de la fourche caudale . . .	121.50
L_1 » » au bord antérieur de l'œil	12.08
L_2 » » au bord postérieur de l'œil	15.82
L_3 » » au point le plus saillant du bord libre de l'opercule (longueur de la tête) . . .	33.51
L_6 » » à la base du rayon I de la 1ère dorsale . . .	35.15
L_7 » » » » » 2ème »	64.40
L_8 » » » » » ventrale	38.68
L_9 » » au bord postérieur de l'anus	73.41
L_{12} Longueur de la pectorale	22.54
L_{10} Hauteur maxima du corps	30.00
L_{13} Distance interorbitaire courbiline (au ruban) . .	14.10
N Nombre de pinnules dorsales	9.07
N' » » ventrales	8.38
P Poids en kg.	28.65

Les indices biométriques, calculés suivant la technique établie par FRADE et HELDT sont exposés dans le Tableau 10 avec leurs valeurs extrêmes et moyennes. En général, la concordance des chiffres avec ceux trouvés par FRADE pour le thon de l'Algarve est très satisfaisante, mais l'on doit tenir compte de la plus forte taille des poissons mesurés par l'investigateur Portugais.

Les pinnules dorsales et les ventrales (N et N' respectivement) sont en nombre très variable. Les résultats obtenus sont les suivants:

	N	N'	N	N'	%
	°	%			
7	0	1	8 + 7	1	
8	5	62	8 + 8	5	
9	83	35	9 + 8	58	
10	12	2	9 + 9	23	
			10 + 9	12	
			9 + 10	2	

La répartition des tailles (mesurées au demi-centimètre) et le poids des exemplaires (au kilogramme près) sont rapportés dans le Tableau 11. En ce qui concerne les tailles, il faut rappeler qu'elles ont été choisies en vue

Tableau 10. Thon de la côte Basque: Données biométriques.

Indices	Min.	Moy.	Max.	Indices	Min.	Moy.	Max.
$Oi_1 = 2l_3/l_1 + l_2$	2.15	2.402	2.62	$Hi = l_5/l_{10}$	3.63	4.050	4.29
$Oi_2 = l_3/l_5 - l_1$	6.28	8.559	11.71	$Di = l_5/l_6$	3.21	3.456	3.68
$Oi_3 = l_3/l_{13}$	1.91	2.376	3.07	$Di' = l_5/l_7$	1.81	1.860	1.96
$Ti = l_5/l_3$	3.44	3.625	3.85	$Vi = l_5/l_8$	2.96	3.141	3.39
$Pi = l_5/l_{12}$	4.86	5.390	6.43	$Ai = l_5/l_9$	1.57	1.655	1.75
$Pi/Ti = l_3/l_{13}$	1.37	1.486	1.82	l_9/l_7	—	1.139	—

de l'étude biométrique; donc leurs fréquences deviennent inexpressives quant à la composition réelle de la population.

Tous les poissons étaient à sexe indéterminable, à gonades non mûres. L'examen du contenu stomacal montre la présence de sardines, anchois, chinchards et calmars, qui sont toujours la base de l'alimentation du thon rouge, ainsi que du germon.

Tableau 11. Répartition des tailles et des poids.

L = taille en centimètres.
P = poids en kilogrammes.

L	P	L	P	L	P	L	P
64	5	114	21	122	25	133	32
74	7	114	25	122	26	134	34
74.5	7	115	24	122	27	134.5	35
79	7.5	115	23	122.5	25	136.5	35
79.5	8.5	115.5	23	122.5	25	138	34
81	9	116	22	122.5	25	139.5	40
81	10	116	25	123	26	142	42
81.5	9	117	25	123.5	26	142.5	39
82.5	10	117.5	24	123.5	26	143	40
83	10	118	25	124	28	148	46
83.5	10	118.5	22	124.5	27	149.5	50
85	10	119	25	124.5	28	150	49
85	11	119	25	125	29	151	47
85.5	12	119.5	25	126	29	151	50
89	13	120	25	126	28	152	51
105.5	20	120	26	127	31	153.5	54
108.5	20	120	25	127.5	31	154	49
109.5	21	120	25	127.5	31	154.5	51
110	23	120.5	24	127.5	30	155	53
112	20	120.5	26	129	30	156	50
112	23	121	25	130	31	157.5	54
112.5	21	121	26	130.5	30	158	57
112.5	21	121	26	131	30	160.5	61
113	22	121.5	23	131.5	34	163	64
114	26	122	24	132.5	33	167	75

J. M. NAVAZ.

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Germon (*Germo alalunga* GMELIN).

Observations complémentaires sur sa Biologie.

Au cours de l'année 1949, l'Office Scientifique et Technique des Pêches Maritimes a continué les observations régulièrement entreprises chaque année depuis la reprise de son activité normale sur le littoral.

Ces observations ont porté : sur la biologie générale du Germon (*Germo alalunga*), les conditions hydrologiques sur les lieux de pêche, sur sa nourriture, son état sexuel. Elles ont été complétées par des investigations biométriques faites sur les lieux de pêche, dans les ports de débarquement, ainsi qu'à bord du navire océanographique «Président Théodore Tissier».

Les résultats obtenus jusqu'en 1948 ont été mentionnés dans le «Résumé des Connaissances acquises sur la Biologie du Germon» (*Germo alalunga* GMELIN), présenté par J. LE GALL lors de la Conférence des Experts du Comité Atlantique du Conseil International pour l'Exploration de la Mer (Tunis, Juillet 1949).

Les résultats des observations faites en 1949 viennent compléter ceux déjà présentés à la Conférence de Malaga.

Caractères spécifiques.

JORDAN a cru devoir maintenir une distinction entre les Germons des Océans Atlantique, Pacifique et Indien et en faire deux espèces : *Germo alalunga* GMELIN dans l'Atlantique et *Germo germo* LACÉPÈDE en se basant sur divers caractères métriques de valeur maintenant reconnus douteux, sur la forme du museau, la convexité de la nuque, la coloration des nageoires et la présence de bandes verticales ou longitudinales sur les flancs.

Les observations faites sur les lieux de pêche au large des côtes de France ainsi qu'au débarquement du poisson, ont montré la présence chez *Germo alalunga* GMELIN :

1. sur le bord supérieur des nageoires dorsales d'une coloration jaune comme chez *Germo germo* (LETACONNOUX);
2. de bandes longitudinales et verticales pâles plus ou moins réticulées sur les flancs (PRIOL — LETACONNOUX).

Ces bandes apparaissent sur le poisson lorsque les écailles qui recouvrent les flancs ont été arrachées au moment de sa sortie de l'eau.

Ces observations confirment le doute, déjà émis par la plupart des ichthyologistes, sur la

validité de ces deux espèces et seule doit être reconnue l'espèce *Germo alalunga* GMELIN avec des populations géographiques vraisemblablement distinctes dans les trois Océans.

Ichthyométrie.

Longueur totale.

La méthode Française de mensuration définit comme longueur totale du germon, la longueur mesurée, entre perpendiculaires, du bout du museau (extrémité antérieure de la mâchoire supérieure) au milieu de la ligne joignant les pointes extrêmes de la nageoire caudale en extension normale (soit Lt).

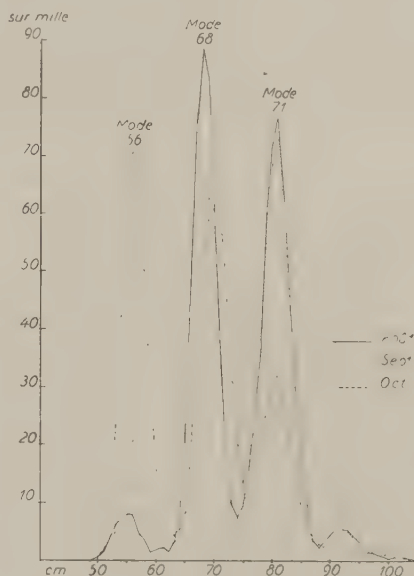


Figure 10.

La méthode Américaine définit cette longueur comme la distance du bout du museau à l'extrémité postérieure des rayons cartilagineux situés au milieu de la fourche caudale, (soit Lc).

Cette différence d'appréciation de la valeur numérique d'un caractère important nous avait conduit à établir la corrélation entre les deux mesures et à établir que $Lt = Lc \times 1.07$.

De nombreuses mensurations ($N = 1.027$) faites par LETACONNOUX et ses collègues à bord du «Président Théodore Tissier» et par E. P. PRIOL au débarquement du poisson

Tableau 12. Représentation $\frac{0}{100}$.

cm.	49	50	51	52	53	54	55	56	57	58	59	60	61	62
$\frac{0}{100} \dots$	0.1	0.3	1.2	4.1	11.5	21.4	29.6	32.5	28.8	21.8	14.2	8.6	5.4	3.4
cm.	63	64	65	66	67	68	69	70	71	72	73	74	75	76
$\frac{0}{100} \dots$	3.5	6.4	13.1	28.4	48.5	63.3	68.4	57.4	43.6	28.0	22.1	12.9	11.3	14.9
cm.	77	78	79	80	81	82	83	84	85	86	87	88	89	90
$\frac{0}{100} \dots$	21.5	31.9	48.3	58.0	60.5	49.3	36.4	26.3	15.1	9.5	4.3	2.8	2.7	2.9
cm.	91	92	93	94	95	96	97	98	99	100	101	102	103	104
$\frac{0}{100} \dots$	37	3.9	4.0	3.8	2.9	2.3	1.6	1.1	0.9	0.7	0.8	0.5	0.5	0.3

Modes = 56 — 69 — 81 — 93 correspondant aux groupes: II — III — IV — V

Longueur moyenne dans chaque groupe, cm.

Groupe II — $56.43 + 0.50 = 56.93$

Groupe IV — $80.75 + 0.50 = 81.25$

Groupe III — $69.22 + 0.50 = 69.72$

Groupe V — $92.83 + 0.50 = 93.30$

permettent de confirmer le coefficient indiqué, établi à:

$k=1.068$ sur le poisson au sortir de l'eau
 $=1.082$ sur le poisson au débarquement
 $=1.0771$ sur l'ensemble des individus examinés.

Taille, Âge, Première maturité sexuelle.

Les nombreuses mensurations faites au cours de ces dernières années (PRIOL-LETACONNOUX-ANCELLIN-FOREST) ont montré dans l'Atlantique nord-est, au cours de la dispersion trophique de ce poisson, la présence dans les bancs, de germes d'une longueur totale (mesurée entre perpendiculaires du bout du museau au milieu de la ligne joignant les pointes de la caudale), de

45 cm. à 115 cm.

se répartissant autour d'un certain nombre de classes modales:

55 à 57 66 à 69 79 à 81 90 à 93

correspondant certainement avec des classes annuelles de recrutement des bancs.

Les mensurations faites au cours de l'année 1949 (plus de 16,000 individus mesurés: PRIOL-LETACONNOUX et leurs collègues) ont confirmé la présence de ces classes en établissant leur représentation, voir Tableau 12.

Me basant sur les travaux Américains, en particulier BROCK 1943, signalant entre Janvier et Mai 1937 la présence entre le 28° et le 34° N. et du 170° au 173° W. Gr., de germes de 23 à 29 cm. de long, taille moyenne 25 cm. (soit près de 27 cm. mesurés du bout du museau à l'extrémité de la queue suivant la technique Européenne), j'ai admis que les germes de

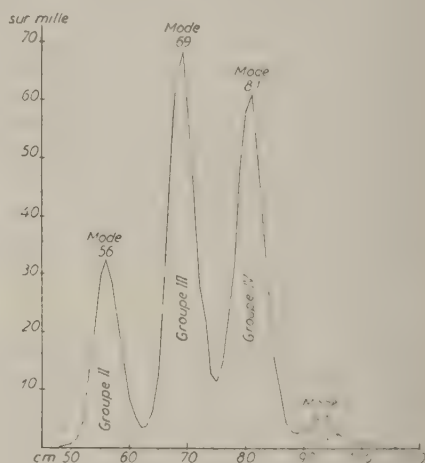


Figure 11.

cette taille appartenait au groupe 0 et que ce poisson atteignait une longueur de

cm. env.	à la fin de l'année d'existence
25 » » »	première
46 » » »	deuxième
60 » » »	troisième
74 » » »	quatrième
88 » » »	cinquième

et défini les groupes suivants:

groupe	taille, cm.	mode	an	an révolu
0	<25			
I	25—46			1
II	46—60	54—56	2 à 3	2
III	60—74	68—70	3 à 4	3
IV	74—88	78—82	4	

et que les germes atteignaient leur première maturité sexuelle à l'âge de 4 ans, c'est-à-dire

au cours de leur cinquième année d'existence, quand leur taille atteint 74 centimètres.

La croissance du germon serait donc rapide au cours de ses deux premières années d'existence (25 cm. + 20 cm.) se ralentirait au cours des deux années suivantes (14 cm. + 14 cm.) pour diminuer rapidement ensuite après la première maturité sexuelle.

Représentation mensuelle.

Ces résultats précédents groupent toutes les observations faites sur des germons provenant des différents lieux de pêche du Golfe de Gascogne et des accores de la Mer Celtique, pendant les mois d'Août, Septembre et Octobre, au cours desquels la pêche du germon est à son maximum.

Il nous a paru intéressant d'établir, en outre, d'après leur taille, la représentation proportionnelle des germons capturés au cours de chacun de ces mois successifs :

Tableau 13.
Représentation mensuelle %.

cm.	Août	Sept.	Oct.	cm.	Août	Sept.	Oct.
49	0.1	0.1	0.1	78	37.4	39.4	19.0
50	0.4	0.1	0.3	79	59.7	59.4	25.9
51	1.9	0.2	1.4	80	72.5	71.0	30.6
52	4.0	1.7	6.7	81	76.8	73.0	31.7
53	6.6	5.6	22.2	82	62.9	58.2	26.9
54	8.0	12.1	44.1	83	45.0	43.6	20.5
55	8.1	18.0	62.7	84	29.0	35.0	14.9
56	5.7	21.1	70.7	85	16.0	19.6	9.7
57	3.2	19.4	83.5	86	10.1	11.4	7.0
58	1.5	16.0	48.0	87	3.6	5.9	3.5
59	1.7	11.5	29.4	88	2.1	3.5	2.7
60	1.9	8.0	16.0	89	3.3	2.8	2.2
61	2.1	5.0	9.2	90	4.4	2.4	2.0
62	1.6	3.5	5.2	91	5.5	4.0	1.7
63	3.0	3.1	4.3	92	5.4	4.5	1.7
64	9.1	4.8	5.2	93	5.3	5.0	1.8
65	21.8	8.4	9.2	94	4.7	4.5	2.1
66	47.1	18.5	19.5	95	3.4	3.7	1.8
67	76.0	37.7	34.8	96	2.1	3.5	1.3
68	88.2	50.2	59.0	97	1.4	2.4	0.7
69	83.5	59.0	62.7	98	0.9	2.0	0.4
70	56.6	56.0	59.6	99	0.8	1.2	0.6
71	36.9	45.5	48.3	100	0.2	1.1	0.7
72	17.3	34.8	32.0	101	0.2	1.2	0.8
73	10.1	23.6	18.3	102	0.1	0.7	0.6
74	7.6	16.7	14.5	103	0.4	0.6	0.5
75	9.8	13.4	10.8	104	0.3	0.5	0.2
76	15.1	18.2	11.3	105	0.2	0.4	0.2
77	24.7	27.0	12.7	106	—	0.2	0.1

L'examen des chiffres ainsi obtenus montre nettement que :

a) les germons du groupe II, tailles modales 55/56, relativement nombreux en Août, augmentent encore dans les bancs au cours des mois de Septembre et d'Octobre ;

b) ceux du groupe III, tailles modales 68/69, abondants en Août, diminuent ensuite en Septembre et conservent la même représentation proportionnelle en Octobre ;

c) les germons du groupe IV, tailles modales 80/82, relativement peu abondants en Août, le deviennent en Septembre et Octobre. Ces germons ont atteint l'état adulte et ont vraisemblablement pondu pour la première fois avant leur dispersion trophique présente.

Les observations n'ont pas porté sur un nombre suffisant d'individus plus âgés pour permettre une conclusion précise quant à leur abondance relative dans les bancs au cours de ces trois mois d'observations.

Ces résultats confirment les conclusions précédemment énoncées sur l'apparition dès le début de la période de dispersion trophique dans le Golfe de Gascogne et en Mer Celtique

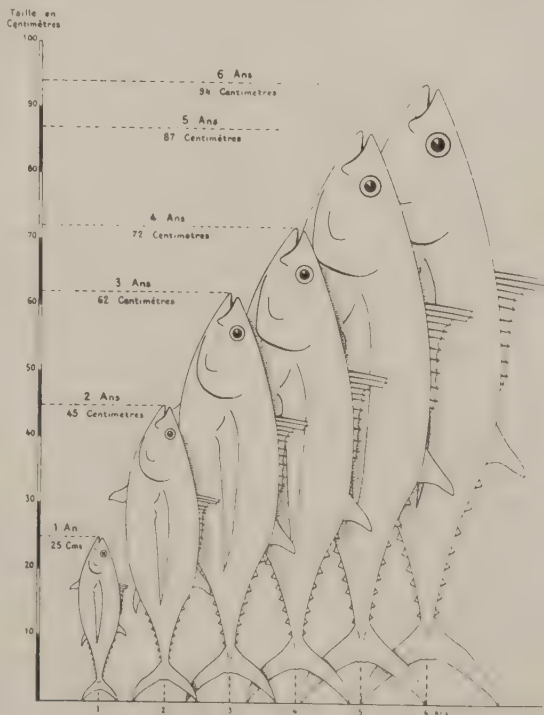


Figure 12.

des germons immatures (groupes II et III) et l'arrivée plus tardive dans ces mêmes régions des germons adultes (groupes IV et plus âgés). Il apparaît également que ces adultes sont les premiers à disparaître.

Il se confirme également que les germons de plus d'un mètre de long et d'un poids supérieur à 20 kg. abondants autour des Açores, de Madère, au large des côtes de Mauritanie et du Maroc, restent rares au large des côtes Européennes. Leur migration septentrionale, en période de dispersion trophique, est donc relativement de faible étendue.

Distribution et déplacements.

Germo alalunga GMELIN est essentiellement un poisson pélagique se maintenant généralement dans les eaux de surface jusqu'à une profondeur n'excédant pas 200 à 300 mètres.

Les observations faites jusqu'à présent n'ont pas permis de le capturer au-delà de cette dernière profondeur.

Il se maintient, à toute époque de l'année, dans les eaux Atlantiques d'une température supérieure à 14° C. et d'une salinité supérieure à 35.5‰. Ce n'est qu'exceptionnellement que sa présence a été observée dans des eaux à 13.8° et d'une salinité de 35.38‰ et ceci à la limite des eaux Atlantiques chaudes et salées et dans leur voisinage immédiat. (Relevé des observations faites jusqu'en 1949).

Il se déplace chaque année avec ces eaux Atlantiques dans leur mouvement périodique de transgression et de régression sans jamais sortir de leur domaine actuellement bien défini et son apparition et sa disparition au large des côtes d'Europe correspond avec ce mouvement.

Ce déplacement est entrepris chaque année par des germons: — d'une taille de 45 cm. à 75 cm. de long, généralement immatures, supérieure à 75 cm. de long (jusqu'à 1.15 m.), adultes en période de dispersion trophique après la ponte sur les frayères de l'espèce.

On ignore encore actuellement à quelle époque de l'année et où se font les concentrations de ponte. Les dernières recherches du «Président Théodore Tissier» ont permis de fixer la ponte après la fin d'Avril sans pouvoir préciser sa durée.

Statistiques.

L'année 1949 a été exceptionnellement bonne pour la pêche du germon dans le Golfe de Gascogne et en Mer Celtique et la quantité de germons débarqués de Juin à la fin de Novembre s'est élevée à 13,601 tonnes se répartissant mensuellement ainsi:

Juin ¹⁾	Juillet	Août	Sept.	Oct.	Nov. ²⁾
tonnes: 4	4,010	3,775	3,379	2,427	6

JEAN LE GALL.

Le Germon à la Côte Basque.

Il est bien connu que la pêche du germon dans le Golfe de Gascogne est une pêche saisonnière débutant en Juin pour se poursuivre jusqu'en Octobre, parfois jusqu'à Décembre. La pêche se fait traditionnellement à l'hameçon masqué; mais, récemment l'emploi de l'appât vivant s'est généralisé et des filets tournants à grandes mailles ont été aussi essayés.

Les débarquements annuels au port de Saint-Sébastien dans la période 1942—1949 sont en moyenne de 347 tonnes:

1942 = 95.3 tonnes	1946 = 300.8 tonnes
1943 = 269.1 »	1947 = 296.7 »
1944 = 452.4 »	1948 = 483.6 »
1945 = 527.9 »	1949 = 393.3 »

Les pourcentages mensuels moyens pour cette période sont:

Juin 2.5	Septembre 24.5
Juillet 35.7	Octobre 15.6
Août 21.0	Novembre 0.3

Tableau 14. Germon: Données biométriques.

Caractères	Moyenne	Indices	Moyenne	Pinnules
l_5	74.26	Oi_1	2.487	{ dorsales (N) et
l_1	6.46	Oi_2	5.731	{ ventrales (N') et
l_2	10.04	Oi_3	3.000	Fréquences
l_3	20.52	Ti	3.618	%
l_6	23.48	Pi	2.759	N N'
l_7	41.92	Hi	4.146	7 4 16
l_8	23.42	Di	3.162	8 70 84
l_9	46.16	Vi	3.170	9 26 0
l_{10}	17.91	Ai	1.608	Combinations
l_{12}	26.91	l_9/l_7	1.101	Fréquence %
l_{13}	6.48	$D'i$	1.771	N+N'
N	8.22	Pi/Ti	0.763	7+7 4
N'	7.84			8+7 12
P	7.12			8+8 58
				9+8 26

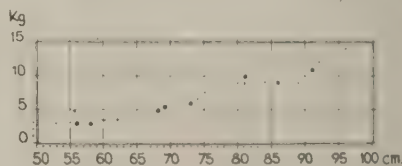


Fig. 13. Germon (Côte Basque): Poids et taille.
Gros points: Double coïncidence.
Croix: Triple coïncidence.

L'étude biométrique de l'espèce a été commencée en 1949 sur le même plan que pour le thon rouge. 50 poissons, de taille variant entre 53 et 96 cm. ont été examinés. Les résultats sont rassemblés dans le Tableau 14; la corrélation taille et poids est représentée par la Figure 13.

J. M. NAVAZ.

¹⁾ début le 10 Juin 1949.

²⁾ fin dans la 2ème quinzaine du mois.

Germon de Galice.

Les 6, 8 et 12 Juillet 1949, cinquante germons ont été examinés à l'usine de conserves de MM. Massó (installée à Cangas, près de Vigo), prélevés parmi trois mille germons entrés dans cette usine pendant ces quelques jours et provenant de la région du Cap Finis-terre Espagnol.

Parmi ces poissons, nous avons trouvé un thon rouge et trois bonites à ventre rayé (*Katsuwonus pelamis*), qui furent également étudiés.

Mensurations et indices biométriques.

Les mensurations L_1 , L_2 , L_3 , L_4 , L_5 , L_6 , L_7 , L_8 , L_9 , L_{10} , L_{12} , L_{13} , et L_{14} , recommandées par les Experts à la «Conférence du Thon» tenue à Madrid et à Cadix en 1932 (1), ont été faites au millimètre près, en projection, à l'aide d'une règle. La distance interorbitaire a été prise au compas à branches courbes. Nous avons également mesuré une autre «longueur totale», délimitée en arrière par l'extrémité de la colonne vertébrale, aisément reconnue au tact. Deux autres mensurations ont été aussi faites: la hauteur maxima du corps et la hauteur minima du pédoncule caudal. Ces trois caractères n'ont pas été pris en considération dans ce rapport.

La taille des exemplaires (L_5) varie entre 436 et 860 mm. (695 mm. en moyenne). La fréquence des tailles, ramenées au demi-centimètre inférieur est représentée sur la Figure 14.

Valeurs moyennes et extrêmes des indices établis à la Conférence du Thon:

Indices	Min.	Moy.	Max.	Indices	Min.	Moy.	Max.
Oi ₁	1.727	2.418	2.823	Pi/Ti	0.652	0.804	1.115
Oi ₂	3.800	5.625	11.500	Di	2.718	3.025	3.300
Oi ₃	1.900	3.003	3.550	D'i	1.526	1.698	1.928
Ti	2.382	3.478	5.210	Vi	2.636	3.000	3.595
Hi	3.954	4.384	4.777	Ai	1.359	1.591	2.169
Pi	2.376	2.823	3.500				

Caractères numériques.

Outre les pinnules dorsales (N) et les anales (N'), les rayons des nageoires dorsales et anales ont été comptés. Les chiffres ci-dessous expriment la variation de ces caractères:

	Minima	Moyenne	Maxima
Rayons à la première dorsale	13	13.86	14
» » » deuxième »	10	13.2 + 0.92	14 + 1
Pinnules dorsales (N)	7	7.55	8
Rayons à l'anale.....	10 + 1	12.3 + 0.78	14 + 1
Pinnules anales (N')	7	7.44	8

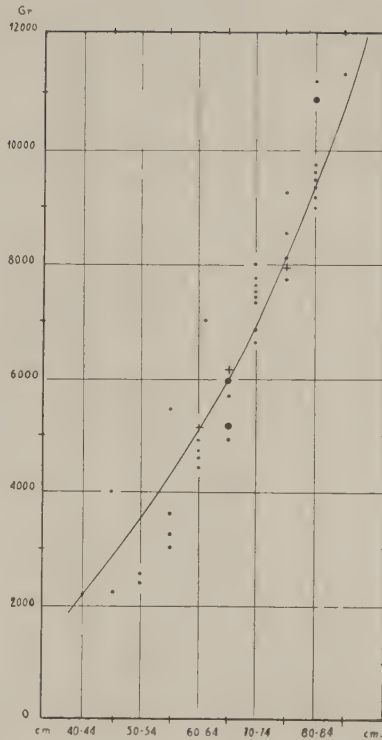


Figure 14. Taille et poids du germon (Galice).

Petits points : Donnée singulière.
Gros points : Double coïncidence.
Croix : Triple coïncidence.

Poids.

Les poissons furent pesés sur une bonne balance (sensible aux 2.5 g.) mais les chiffres ont été rapportés à l'hectogramme le plus proche pour tracer la Figure 14. La valeur moyenne du rapport Poids/Taille (P/T. 1000) est 19.79.

Le foie et les gonades des 50 germons ont aussi été pesés. Le rapport Poids du poisson/Poids du foie, intéressant pour l'industrie, a été calculé; les valeurs minima, moyenne et maxima, sont 17.41, 37.10 et 49.48 respectivement.

Caractères sexuels.

Chez la plupart des individus, les glandes génitales étaient petites; le rapport Poids du poisson/Poids des gonades varie de 2407.0 à 155.0, la valeur moyenne étant 586.7. Cependant, le sexe fut aisément déterminé, excepté

¹⁾ Comm. Intern. Explor. Scient. de la Médit., Rapp. et Proc.-Verb., Vol. VII, Paris, 1932.

chez quelques exemplaires de petite taille. Au-dessous de 62.5 cm. il y a prédominance accentuée des mâles (80%) sur les femelles (12%); chez les autres, le sexe est indéterminable.

Nourriture.

L'examen de la réplétion stomacale nous a montré 23 poissons (43%) à estomac vide, autant à estomac à demi-plein et 4 seulement (8%) à estomac plein. Le contenu stomacal a été analysé pour trois germons: L'un avait l'estomac rempli de *Lepidopus caudatus* et de débris d'un autre poisson, *Rhamphistoma belone* sûrement; les autres étaient repus de sardines et de sprats (identification moyennant les chevrons), ainsi que de *Lepidopus*.

Tous les germons examinés étaient absolument dépourvus de graisse viscérale.

F. LOZANO.

La Bonite à ventre rayé (*Katsuwonus pelamis* L.).

Dans le Golfe de Gascogne.

La présence de la bonite au ventre rayé n'est pas exceptionnelle dans le Golfe de Gascogne et en Mer Celtique. Chaque année, les pêcheurs thoniers pratiquant la pêche du germon en capturent sur leurs lignes et les ramènent. Ces apports sont très variables suivant les années.

L'espèce paraît arriver sur les lieux de pêche fréquentés vers la mi-Août pour disparaître à la fin d'Octobre quand les eaux se refroidissent.

Les apports de bonites ont été plus nombreux en 1949 qu'au cours des années précédentes. Les mensurations faites au débarquement à Concarneau apporteront de nouveaux éléments à la biologie de ce poisson encore mal étudié dans l'Atlantique nord-est.

Origine — Golfe de Gascogne.

Date — mi-Octobre 1949.

Taille — mesurée en centimètres: du bout du museau au milieu de la ligne joignant les pointes de la caudale.

Représentation %.

Centimètres	43	44	45	46	47	48	49	50	51	52	53	54	55
Représentation %	0.5	2.3	6.1	9.2	10.2	7.5	6.0	7.5	7.8	8.0	7.6	6.1	4.9
Centimètres	56	57	58	59	60	61	62	63	64	65	66	67	68
Représentation %	3.1	1.6	1.4	0.6	0.5	0	0.3	0.4	0.8	0.9	1.0	0.5	0.1
Centimètres	69	70	71	72	73	74	75	76	77	78	79	80	
Représentation %	0.2	0.3	0.9	1	0.9	0.5	0.4	0.3	0.3	0.2	0.2	0.1	

N = 198

Observateur: E. P. PRIOL

La présence de *Katsuwonus pelamis* dans le Golfe de Gascogne et en Mer Celtique à cette époque de l'année confirme l'hypothèse d'une dispersion trophique de l'espèce vers le nord, après la ponte, dans les eaux chaudes et salées d'une température en surface supérieure à 16°C. (de 16 à 20°) et d'une salinité supérieures à 35.5‰.

L'espèce disparaît ensuite et, après Octobre, les captures sont exceptionnelles.

Il semble également, ainsi que le fait a été constaté dans le Pacifique, que: lorsque la température de l'eau a été supérieure à la normale pendant l'hiver, les captures de *Katsuwonus pelamis* sont plus abondantes dans le nord. C'est précisément le cas qui s'est présenté en 1949.

J. LE GALL.

Pêchée à la Côte Basque.

La bonite à ventre rayé a déjà été signalée sur la côte nord d'Espagne par les naturalistes et les pêcheurs Basques connaissent bien l'espèce, qu'ils ont dénommée «lampo». Elle apparaît parfois pendant la saison de pêche du germon; son abondance a été remarquable en 1949. Les apports à Saint-Sébastien au cours de trois mois (Septembre-Novembre)

Tableau 15.

Katsuwonus pelamis: Données biométriques.

Caractères	Moyenne	Indices	Moyenne	Pinnules dorsales et ventrales
l_5	46.03	Oi_1	2.859	(N) (N')
l_1	3.46	Oi_2	6.548	Fréquences %
l_2	5.40	Oi_3	2.985	N N'
l_3	12.62	Ti	3.628	7 9.3 65.6
l_4	14.81	Pi	7.515	8 90.6 34.3
l_7	27.59	Pi/Ti	2.071	
l_8	14.31	Hi	4.397	Fréquence des
l_9	29.71	Di	3.107	Combinaisons
l_{10}	10.46	D'i	1.668	N + N'
l_{12}	6.12	Vi	3.216	7 + 7 9.37 %
l_{13}	4.25	Ai	1.548	8 + 7 56.25 %
N	7.906	l_9/l_7	1.077	8 + 8 34.37 %
N'	7.343			

Plus un individu de 85 cm.
Tailles modales: 47 — 52 — 66 — 72.

ayant monté à 42,920 kg. Par contre, les débarquements en 1948 furent 850 kg. à peine.

Le résultat de l'étude biométrique de 32 individus de 43 à 53 cm., pesant de 1.8 à 2.5 kg., est résumé dans le Tableau 15.

J. M. NAVAZ.

Melva (*Auxis thazard*).

Pêchée à la Côte Basque.

La melva n'est pas non plus une nouveauté pour les pêcheurs Basques; ils la dénomment «macaela». Comme le «lampo», elle est parfois capturée, en petite quantité, pendant la saison du germon. A mon avis, aucun ichthyologiste n'avait encore témoigné la présence de cette espèce sur la côte nord d'Espagne.

En début de Novembre, dans un lot de *K. pelamys*, j'ai trouvé deux melvas de 46 cm.

Cette étude, autant que possible, sera poursuivie l'été prochain.

J. M. NAVAZ.

POISSONS DIVERS

Scomberesox saurus WALB. 1792 du Golfe de Gascogne (Le «Balaou»).

Origine: Fond du Golfe de Gascogne — St-Jean-de-Luz — Août 1949.

Nombre d'individus examinés = 100.

I. Caractères biométriques.

Classes	Taille	Rapp.	Valeur de			
	%	ramph. ¹⁾	Di	Vi	Ai	Ei ⁴⁾
20	1	14.94	1.43	1.77	1.47	2.61
21	7	15.65	1.44	1.77	1.46	2.60
22	17	15.94	1.44	1.78	1.47	2.65
23	13	15.68	1.45	1.79	1.48	2.65
24	3	15.44	1.44	1.78	1.48	2.63
25	11	16.09	1.43	1.80	1.46	2.55
26	5	16.08	1.44	1.77	1.46	2.61
27	5	15.41	1.44	1.78	1.48	2.58
28	18	15.54	1.44	1.80	1.47	2.58
29	8	15.45	1.44	1.78	1.46	2.57
30	3	15.51	1.44	1.77	1.46	2.57
31	3	15.41	1.44	1.78	1.47	2.55
32	4	15.05	1.45	1.79	1.47	2.50
33	0	—	—	—	—	—
34	2	15.77	1.45	1.82	1.47	2.49
Val. moy.		15.64	1.44	1.79 ²⁾	1.47 ³⁾	

¹⁾ Rapport ramphotique = $\frac{\text{longueur du bec}}{\text{longueur totale}} \times 100$

²⁾ Très légère tendance à l'augmentation chez les individus âgés.

³⁾ Très légère tendance à un éloignement relatif et discontinu de l'anus par rapport à l'extrémité du bec.

⁴⁾ Rapport entéral Ei = $\frac{\text{longueur totale}}{\text{l. entérale (cavité viscérale)}}$

Notes.

La croissance irrégulière du bec par rapport à la taille ressort du tableau.

Chez les formes très jeunes, le bec est très court par rapport à la longueur totale.

L.c.p.l. — Passe de 30 pour L = 22 cm. à 27.8 pour L = 34 cm. en décroissant irrégulièrement. La tête est donc proportionnellement plus petite pour les grandes tailles.

La longueur relative de la cavité viscérale croît au fur et à mesure que la taille augmente.

II. Caractères numériques.

La présence de vessie natatoire n'a pas été constatée.

Rayons des Nageoires.

	a) Dorsale				b) Pectorales			c) Ventrales	
No. des rayons %	9	10	11	12	12	13	14		
Moy.	11.09	± 0.21			12.95	± 0.18			

	d) Anale				e) Pinnules			
	Rayons				Dorsales		Ventrales	
No. des	11	12	13	14	IV	V	V	VI VII
%	3	26	65	6	5	78	17	6 64 30
Moy.	12.74	± 0.20			5.12	± 0.15	6.24	± 0.18

Moyenne vertébrale.

Nombre de vertèbres.....	65	66	67	68
Fréquence p. 100.....	8	25	27	40
Moyenne vertébrale:	66.99 ± 0.33.			

PAUL V. CREAC'H.

MULLIDAE

Rouget-barbet (*Mullus barbatus surmuletus*).

Mensurations.

Ces observations sur deux échantillons de rougets-barbets, prélevés en deux endroits et à des époques différentes sont données ici à titre purement documentaire.

Date: 1—4 Mars 1949

Lieu: 47° 10 N. et 5° 40 W. Gr.

Engin de Pêche: Chalut.

Taille en cm. (rectifiée).

	Répartition %.									
cm.	21	22	23	24	25	26	27	28	29	
%	0.2	0.7	2.2	3.6	5.8	7.7	10.9	12.2	12.5	

cm.	30	31	32	33	34	35	36	37	38	
%	10.4	10.0	7.8	6.5	3.9	2.5	1.6	0.7	0.6	

cm.	39	40								
%	0.1	0.1	N = 340							

Mode = 29

Moyenne = 29.70 cm.

Date: 15 Septembre 1949.

Lieu de Pêche: embouchure de la Vilaine en

Septembre 1949. Individus immatures.

Engin de Pêche: chalut à crevettes.

		Taille en cm.						
		Répartition %						
cm.	6	7	8	9	10	11	12	13
%	3	9	6	44	15	12	6	5
			Mode = 9					
			Moyenne = 9,90					
N = 34								

Les individus capturés dans le Golfe appartiennent aux groupes III et suivants; les immatures capturés à l'embouchure de la Vilaine au groupe 0.

Ces observations confirment les travaux de DESBROSSES: les jeunes nés en Mai et Juin atteignent, pour la plupart, 9 cm. en Septembre; et, à un an: 14 à 15 cm.

Les rougets-barbets pêchés en hiver par 200 à 300 m. sont des adultes de grande taille en pleine maturation sexuelle. La ponte a lieu en Mai.

L. FAURE et R. LETACONNOUX.

CÉTACÉS

Incursions de Baleinoptères sur les Côtes Tunisiennes.

Il semble bien que certains des baleinoptères dont le Dr. FURNESTIN a signalé l'existence en assez grande abondance entre Tanger et Juby¹⁾,

¹⁾ J. FURNESTIN — Les Baleines. Leur pêche est-elle possible sur les côtes du Maroc? «Revue de la Conserve Marocaine», No. 5, 1949.

passent Gibraltar pour venir excursionner en Méditerranée.

A différentes reprises, en effet, des cétacés ont été aperçus au large des côtes Tunisiennes; et, au cours de ces dernières années il en est venu s'échouer au rivage:

Trois baleinoptères se sont ainsi mis au sec dans les parages des îles Kerkennah: 1937, 1938, 1949. Un autre sujet a fait côte près de l'îlot de Kneis, dans le golfe de Gabès, en 1941, ayant reçu une rafale de mitrailleuse dans les reins. Enfin, le 20 Octobre 1949, un jeune baleineau qui évoluait dans le canal de Tunis a pu être amené à terre et examiné.

1. Le sujet échoué aux Kerkennah le 5 Février 1949 était un *Baleinoptera physalus* (L.) ou «Fin Whale», long d'environ 13 mètres et âgé d'un an et demi.

2. Le jeune cétacé capturé dans le canal Tunis-Goulette le 21 Octobre 1949 était un nourrisson de *Baleinoptera borealis* LESSON, le Rorqual de RUDOLF ou «Sei-Whale» de 5.85 m. de longueur totale. Il n'était âgé que de 2 à 3 mois et mesurait 5 mètres à sa naissance.

Les indications ainsi que les déterminations indiquées ont été fournies par le Prof. JOHAN T. RUUD d'après des documents photographiques et l'examen des fanons.

3. Le baleinoptère de la Skira de 1941 était un sujet de grande taille. Il doit être rapporté à *Baleinoptera physalus*. C'est la forme de la première vertèbre qui a permis au Dr. DEGERBØL de Copenhague, de conclure sur ce point.

H. HELDT.

Northern North Sea.

REVIEW.

WHILST conditions have improved somewhat during the course of the year, it was possible for only the Scottish vessels to maintain a general survey over the Northern North Sea throughout the year, in association with investigations in the Faroe-Shetland Channel and to the west. Despite the various difficulties, however, the most helpful co-operation has been brought about by exchanges of material and information, by the organisation of returns of marked fish and drift bottles, and in various other ways.

During the year, comparative trawling experiments have been carried out, both between commercial and experimental trawls from the vessels of the Scottish Home Department's Marine Laboratory at Aberdeen, as well as between a 46 ft. Northern North Sea trawl used from F.R.S. "Explorer" and a 48 ft. Southern North Sea net from F.R.S. "Sir Lancelot" (Ministry of Agriculture & Fisheries), on a Southern North Sea flatfish ground, both ships using their gears with and without tickler chains. It is expected that results from these experiments will be given in one of the Council's publications. Observations have also been made on the action and dimensions of trawls, using the echometer.

Investigations have been begun on the post-war lobster stocks of the north-east coast of Scotland in relation to those of the north and west coasts, a preliminary report of which will be published in the *Rapports et Procès-Verbaux*.

During January, February and March, 1949, the herring research vessel "Clupea" operated in the Firth of Forth area, and from then until August she worked on the various herring grounds off the north-east coast of Scotland. During these cruises, regular observations were made on the herring stocks, using the echometer and the bathythermograph. Herring were again tagged, using the methods of 1948, and preliminary returns of tagged fish were obtained. F. R. S. "Kathleen" operated throughout the year in the inshore waters off the east, north and west coasts of Scotland.

Since several of the reports which follow are based on data collected by the larger Scottish vessels, it may be useful if brief notes on their cruises are given:

February/March	Faroe/Shetland Channel . . . ("Scotia")
	North-western North Sea . . . ("Explorer")
April	Central North Sea ("Scotia")
April/May	Faroe/Shetland Channel and Iceland ("Scotia")
	North-western North Sea . . ("Explorer")
May/June	Waters off the west coast of Scotland . . . ("Explorer")
June	North-western North Sea . . ("Scotia")
July	Central North Sea ("Explorer")
July/August	Faroe and the oceanic fishing banks . . ("Scotia")
August	North-western North Sea . . ("Explorer")
September	Faroe/Shetland Channel . . . ("Scotia")
	North-western North Sea . . ("Explorer")
October	North-western North Sea . . ("Scotia")
	Central North Sea ("Explorer")
November	Faroe/Shetland Channel . . . ("Scotia")
	Central North Sea ("Explorer")
December	Local waters . . ("Explorer")

A. Environment.

Hydrographical observations of temperature and salinity, together with surface drift-bottle results, show that 1949 was marked by a very strong oceanic influence in the North Sea, particularly on the eastern side. A striking feature was the almost complete absence of drift-bottle recoveries on the British coast. This oceanic influence was first shown by the increased numbers of drift-bottles stranded on the Norwegian coast, culminating in May. From then onwards there was a marked southerly movement of water, which developed in June when

many strandings occurred on the west Danish coast, and in July and August when the coast of Schleswig-Holstein down to 54° N. received most of the strandings. Such south-eastern recoveries are relatively rare and suggest strong penetration from the north. A recession followed culminating probably in October/November, only to give rise to an increase again in January, 1950. Temperatures and salinities were generally high, particularly on the eastern side of the area.

Plankton data from the more extensive observations of 1949 are suggesting a distinction in the Faroe Channel between the waters on the north-western side, coming more from the central part of the Atlantic, and those on the south-eastern side, having a communication more with Spanish waters and those of the Azores rather than with the central Atlantic. There appears, in fact, to have been a good penetration of these south-eastern ("Lusitanian") waters into the Northern North Sea during the latter part of the year.

After being absent from the Scottish collections for several years (including those of the war), *Salpa fusiformis* was found in a few samples over the western banks in July and August 1949, and in the North Sea in November. It was of particular interest that *Sagitta elegans* was found during this year to extend further to the eastern side of the North Sea than usual during the early part of the year and to be more limited to the north-western waters in the autumn, presumably in association with the water movements.

B. The Fish.

Records of the eggs and young of the important commercial fishes are still scanty in relation to the large area to be investigated, whilst the experimental introduction of improved methods prevents complete comparison between this and previous years.

Haddock. Detailed analyses of the North Sea stocks show that the 1949 population consisted almost entirely of fish under six years of age. Following the poor recruitment of 1946 and 1947 the marketable shoals in 1949 were smaller than in 1948. The 1948 brood, however, was strong again, and members of this brood entered the fishable stocks in the autumn, especially on the southern grounds. An estimate has been made of the total mortality rate of the present stock, giving approxi-

mately 64%, which compares with the figure of approximately 65% for the inter-war period. At present, the data do not permit separation of the "fishing" from the natural mortality rate. Landings and catch per unit of effort from nearly all the areas of the North Sea were less during 1949 than in 1948, approximately equalling those of pre-war years.

Whiting. A preliminary survey of commercial whiting statistics from British fisheries shows that, whilst total whiting landings decreased during the war, this decrease was much less marked in the Northern North Sea than in the Southern. The post-war Scottish landings (Northern North Sea) are much greater than before the war, as is the unit catch, whereas there was no great change in the latter for the Southern North Sea. The essential reasons for this differential change are not yet clear.

Plaice. Investigations into the influence of seine netting in the Scottish inshore and the nearer offshore fisheries have been continued and are indicating the changes which have taken place since this method of fishing was introduced. These changes in their turn are having their inevitable effects upon the local stocks of plaice, particularly where the fishing is unrestricted.

Halibut. Preliminary analyses of the Aberdeen landings of halibut, and catches per unit of effort, have shown that in the North Sea these have improved considerably, both for trawlers and particularly for liners, since the war. These changes resemble similar ones found in the fisheries off the west coast of Scotland, as also for the Faroe, Iceland and Greenland fisheries, and it is by no means certain that they are simply due to the wartime rest from fishing. At least in the north-western areas it seems likely that the recent increases are the outcome of good brood years just before the war.

Herring. The results of herring investigations in the area will be given in the reports of the new Herring Committee.

Sprat. Preliminary investigations into the relationship between sprat recruitment and the Norwegian sprat fishery are suggesting a correlation between the sizes of 0-group fish and the number of vertebrae, the larger fish having a slightly greater number of vertebrae than the smaller ones.

C. E. LUCAS.

ENVIRONMENT.

Hydrography.

As will be seen by comparing the following figures with those given in the corresponding report for 1948¹⁾, hydrographical work by Scottish research vessels was considerably extended during 1949. A total of 6600 combined temperature-salinity observations was recorded at 890 positions in the North Sea, the Faroe-Shetland Channel, west Scottish waters, and the north-eastern Atlantic Ocean between Scotland and Iceland. Oxygen and phosphate contents at surface and subsurface levels, to the number of about 550 of each, were also determined in course of the year.

Surface drift-bottles were liberated in groups of five from 429 selected positions on the cruises of the research vessels. In addition, 585 drifters were put out regularly throughout the year *en route* from the Firth of Clyde to the British Weather Ship Station I in latitude 60° N., longitude 20° W.

An overall review of the year's hydrographic results suitably commences with a consideration of drift-bottle records. Despite a low recovery ratio of only 15½ per cent. up to the end of March 1950, from the research vessels' liberations, and an even lower return of under 10 per cent. of the Weather Ships' output, these results provide valuable pointers to the course of hydrographic change throughout the year in the Northern North Sea, and link up the early hydrography of 1949 with that of the last quarter of the preceding year.

It may be recalled that, as indicated by certain drift-bottle results and fully supported by temperature-salinity distributions, the last quarter of 1948 was marked by a considerably increased inflow of oceanic water into the northern North Sea by way of the Faroe-Shetland Channel. The remarkably high intensity of the incursion at its peak in October 1948 was signalled by minimum average drift-speeds of between 13 and 14 miles per day which are reminiscent rather of spring than of autumn drift currents. Although tending to wane towards the end of the year, this powerful autumnal accession of 1948 to the Atlantic influence in the northern North Sea evidently, on the basis of further drift-bottle results from that year's liberations, continued into 1949.

Among the earliest drift-bottle recoveries from the Weather Ships' liberations of 1949 are several which clearly imply a minimum average drift-speed of between 11 and 12½ miles per day in the Atlantic Drift current through the Faroe-Shetland Channel during the month of January 1949. Slightly later records from the same region, involving the month of February, yield drift-speeds of around 9 miles per day for that month, signifying a waning in the intensity of the oceanic current north-eastwards through the Channel.

Turning now to North Sea records, marked concentrations of drift-bottle recoveries on the west Danish coast north of Blaavandshuk and on Skagerak shores during February 1949, particularly in the first half of the month are indicative of a strong impulse from the north directed southwards into the North Sea during the first two months of the year. This impulse, which, as will be evident later from a consideration of temperature-salinity distributions, was of Atlantic origin, affected the eastern much more than the western side of the North Sea, not only in the beginning, but throughout the entire year. Despite considerable numbers of North Sea drift-bottle liberations west of the prime meridian in all months from January until December, except February and May, not a single British coast recovery resulted therefrom, save for two isolated instances of Shetland recoveries from nearby liberation positions. In this dearth of British coast returns the 1949 drift-bottle results are even more striking than those of the previous year.

On the other hand, in 1949, eastern North Sea seaboard, including Skagerak, recoveries occurred, with certain interesting fluctuations in numbers of which more below, in all months from January until December inclusive, and indeed also in the first three months of 1950.

That the above-mentioned southerly-directed impulse was a strong, but diminishing and retracting force in the first quarter of 1949, is indicated by the following deductions and circumstances. Minimum average drift-speeds through the central North Sea and into the Skagerak of nine miles per day in January, falling to under eight miles per day towards the end of February, are deduced from a number of significant returns from January liberations

¹⁾ Annales Biologiques, Vol. V, 1948, pp. 53—56.

between Scotland and Denmark. West Danish coast recoveries from these liberations occurred in diminishing numbers throughout February and were entirely absent from the records of March recoveries. Skagerak returns also declined by nearly 50 per cent to a minimum in March, while at the same time North Sea Norwegian coast recoveries only began to appear in March and rose to a maximum in May. This increase, however, was part of a wider tendency commencing in April and arguing renewed accession in that month to the strength of the oceanic incursion from the north.

Skagerak returns also again increased in numbers in April and attained maximum frequency in June. West Danish coast recoveries north of Blaavandshuk reappeared in the records in April and reached maximum numbers also in June. Furthermore, a new class of recoveries for 1949 began to occur in the month of May and increased steadily to maximum numbers in August. These were Schleswig-Holstein coast recoveries which, in years when they do occur, may safely be taken as indicative of strong oceanic influence from the north pushing far down into the North Sea. In support of the argument is the circumstance that both west Danish and Skagerak returns, which in the following month declined from the June maxima, also showed, however, secondary maxima in August more or less equivalent in magnitude to the February figures for both districts.

Thus, the waning force deduced as characteristic of the first quarter of the year reached its nadir in March, thereafter again increasing in intensity and extending its influence southward to a maximum in both respects in August, after which it again declined and gradually withdrew its influence northward as shown by recurrent maxima of drift-bottle returns in the month of October from Skagerak and North Sea Norwegian coasts as well as from still farther north along the latter coast.

From drift-bottle returns we can go even farther. From October until the end of the year there was a decline in the number of recoveries effected on eastern North Sea shores. The month of January 1950, however, showed a sharp rise in the returns recorded from the North Sea coast of Norway. Two months later Skagerak returns showed a similar rise and in the same month an increased number of strandings of 1949 drifters took place along the Norwegian coast outwith the North Sea.

The deduction is that oceanic influence in the Northern North Sea and off the Norwegian coast northward therefrom reached a minimum in the last month probably of 1949 and thereafter revived again to a crescendo in March 1950.

It is now to be seen how far temperature and salinity observations collected during the year bear out the foregoing deductions from drift bottle results.

In the latter half of January 1949 seasonally high temperatures to over 7.5°C. and high salinities embracing Atlantic water ($> 35.00\text{‰}$) were found in the central North Sea region to the northern edge of the Dogger Bank. Positive anomaly in both characters was thus very marked and supports the drift-bottle indications of abnormally strong oceanic influence for the time of year.

In the month of March when the same region was again surveyed there was an appreciable decline in oceanic characteristics as signified by the general occurrence of salinity values less than 35.00‰ and of temperatures which scarcely rose above 6°C. Farther north on the other hand, between latitudes 60°N. and 61°N. , temperatures between 8°C. and $8\frac{1}{2}^{\circ}\text{C.}$ and salinities up to 35.35‰ were decidedly above average values for the month, and suggest that the decline in the oceanic influx to the northern North Sea between January and March, while distinct, was a relatively small one. This inference is borne out by conditions observed in the Farøe-Shetland Channel in March, temperatures of 9°C. as were then recorded in the Atlantic Drift current of 35.35‰ salinity being at least 1°C. above the average.

By mid-April there was evidence in increasing salinity east of Shetland of a revival in the strength of the Atlantic water inflow to the northern North Sea, although conditions in the central region below the latitude of about $57^{\circ}30'\text{N.}$ were found to be slightly below normal in that month.

Immediately southward of the Wyville-Thomson Ridge in the third week of May, salinities in excess of 35.40‰ , accompanied by temperatures of 10°C. and over, were significant of increased intensity in the Atlantic Drift current as compared with two months previously, and in the north-western North Sea this increase in oceanic influence was reflected by May temperatures showing positive anomaly of 1°C. to $1\frac{1}{2}^{\circ}\text{C.}$ and salinities likewise above, but only just above, normal values.

Much greater salinity as well as temperature anomaly was observed east of the 2° E. meridian in the month of June when water of 35.30‰ salinity was found as far south as the latitude of Stavanger ($58^{\circ}50'$ N.) and only some 60 miles off the Norwegian coast. Temperature anomaly on the other hand, while positive, at $+0.5^{\circ}$ to $+1.0^{\circ}$ C., was not so marked as might have been expected in view of the extraordinarily high salinities encountered. When compared with conditions west of longitude 2° E., however, the deduction from drift-bottle results to the effect that oceanic influence was stronger on the eastern than on the western side of the North Sea is fully borne out. In the northern-western North Sea, salinities between 35.10‰ and 35.20‰ , except in the immediate vicinity of Shetland where somewhat greater values occurred, were only just normal for the month.

Inadequate eastern North Sea records for July and August render the step by step sequence up to maximum oceanic influence in the North Sea in the latter month, as suggested by drift-bottle records, somewhat difficult to follow on a preliminary survey of temperature-salinity data. Conditions in the western half of the region during these months tended on the whole to remain normal or only slightly above average. On the other hand there was evidence in the eastern part of the central North Sea in July, on the northern edge of the Dogger Bank, of oceanic water underlying a much fresher upper layer emanating from the Skagerak. Better confirmation of the drift-bottle indications derives from the temperature-salinity distribution in the northern North Sea east of longitude $1^{\circ}30'$ E. in the first week of September, when positive temperature anomaly up to nearly 2° C. and salinities between 35.25‰ and 35.30‰ , overlain by only slightly fresher water from Norwegian coastal reaches, clearly indicate a stronger Atlantic water surge into the northern North Sea than is usually characteristic of the month of September. Moreover, in the same month in the Faroe-Shetland Channel region, temperatures of around 13.75° C. and salinities up to 35.35‰ over the Wyville Thomson Ridge were similarly indicative of abnormally strong oceanic influence for the season.

The same indication was forthcoming in November when, in the same region, temperatures of $11\frac{3}{4}^{\circ}$ C. to 12° C. showed positive anomaly of at least 2° C., while a salinity of between

35.30‰ and 35.34‰ was still at this period characteristic of the core of the North Atlantic Drift current through the Faroe-Shetland Channel.

The month of October in the western central North Sea, with upper water temperatures of $10\frac{1}{2}^{\circ}$ C. to $11\frac{1}{2}^{\circ}$ C., and average salinity values, afforded indirect evidence, as compared with conditions two months previously, of the withdrawal from a maximum, as deduced from drift-bottles, in the intensity of oceanic influence from the north. November material, however, from the western half of the North Sea between latitudes $55^{\circ}30'$ N. and 61° N. again suggested a slight revival of the oceanic influence in so far as temperature anomaly from the south-northward ranged from about $\frac{1}{2}^{\circ}$ C. to $1\frac{1}{2}^{\circ}$ C., salinity showing some more or less irregular variation above and below normal from one part of the region to another.

Unfortunately, observations taken in December were too few and localised to permit of more than merely tentative deduction from them, but with the indications of drift-bottle results on eastern North Sea shores during the following month in mind, a tendency to increased positive temperature, and more definitely positive salinity, anomalies can actually be distinguished in the few observations available west of longitude 1° W. between the Firth of Forth and the northern part of the Moray Firth.

Thus, although for the last quarter of the year temperature and salinity distributions, on a preliminary survey of such data as are available, are far from conclusive in relation to oceanic influence in the northern North Sea, there would seem, on the other hand, to be no question of the significance of the high anomaly in both characters in the Faroe-Shetland Channel in November, coupled with the continuity in all months of eastern North Sea, especially Skagerak, recoveries of drift-bottles, this notwithstanding the fact of a wide superficial extension westward to at least longitude 1° E., from about mid-June to September, of Baltic and Skagerak water effluent.

In lesser degree there was noticeable throughout the year a greater extension eastward over open sea areas of fresher water than is normally met with off the Scottish coast south of Aberdeen and extending almost to the Yorkshire coast.

Brief comment on the oxygen and free phosphate determinations made during the year concludes this report. The regions invest

igated were the Faroe-Shetland Channel including the Wyville Thomson Ridge, and the northern and central parts of the North Sea.

Between the Butt of Lewis and Faroe Bank, over the Wyville Thomson Ridge, oxygen determinations were made in May, September and November, and phosphate determinations in May and November. Despite small differences overall in the oxygen values, the following tendencies were evident. Between Faroe Bank and the Wyville Thomson Ridge, oxygen content increased somewhat irregularly with depth to constant values below 200 metres. In May these values were from 6.0 ml. per litre at the surface to above 6.5 ml. per litre in bottom waters. September figures were from 5.8 ml./L. (surface) to 6.5 ml./L. (bottom) and November values correspondingly from 6.1 ml./L. to above 6.5 ml./L.

By contrast the region south of the Wyville Thomson Ridge to the Butt of Lewis showed diminishing oxygen content from surface to bottom with the lowest values (less than 5.1 ml./L.) occurring either in the deep water south of the Wyville Thomson Ridge (May), or on the Continental Shelf near the Butt of Lewis (September). The lowest oxygen values (< 5.6 ml./L.) in November were characteristic of the water from the continental edge to the deepest sounding in over 1,000 metres.

Between Faroe and Shetland oxygen content was determined in March and November, and much greater differences in the values obtained were at once apparent as compared with the Wyville Thomson Ridge region. In March particularly the sectional picture was a complex one with irregular surface values ranging from just under 5.8 ml./L. to nearly 9.8 ml./L. in the open waters in mid-Channel. Under both these values minima of under 4.0 ml./L. and under 6 ml./L. respectively, occurred within the uppermost 100 metre water layer. The general tendency laterally within this layer was for the oxygen content to diminish from an average value of about 7.0 ml./L. near Faroe to about 5.5 ml./L. towards Shetland. The great bulk of the waters below 100 metres registered comparatively constant oxygen content of between 4.4 ml./L. to 5.0 ml./L.

In November on the other hand the lower water masses from 200 metres down showed appreciably higher oxygen content at from 5.6 to 6 ml./L. as compared with March, while the upper water content, less complex than

before, ranged only from about 5.6 ml./L. to little over 5.8 ml./L.

As regards free phosphate content the waters from Faroe Bank to the Butt of Lewis showed remarkable constancy in the month of May at an average value of $0.8 \mu\text{g.-atom/L.}$ of phosphate-phosphorus. The tendency was, however, for lower values to under $0.4 \mu\text{g.-atom/L.}$ to occur in the near vicinity of Lewis and for the bottom waters between Faroe Bank and the Wyville Thomson Ridge to be slightly stronger in phosphate-phosphorus to just over $1.0 \mu\text{g.-atom/L.}$

In November the phosphate content was slightly lower over the same region except near Lewis where minimum values of over $0.4 \mu\text{g.-atom/L.}$ — mostly over $0.45 \mu\text{g.-atom/L.}$ — were recorded. Surface values, however, were generally below $0.7 \mu\text{g.-atom/L.}$ save in the vicinity of Faroe Bank, where they rose to $0.75 \mu\text{g.-atom/L.}$ Bottom waters also contained less phosphate-phosphorus in November than in May, scarcely reaching $0.95 \mu\text{g.-atom/L.}$ in the former month.

Free phosphate was likewise in slightly greater concentration between Faroe and Shetland in March than in November 1949, save in bottom waters. The range in March was similar to that for May in the Wyville Thomson Ridge region, namely, from about $0.8 \mu\text{g.-atom/L.}$ in the upper, to over $1.0 \mu\text{g.-atom/L.}$ phosphate-phosphorus in bottom waters, again with the tendency in upper waters for higher values to prevail in the Faroe area than towards the eastern end of the section. Figures for November ranged in upper layers from just over $0.75 \mu\text{g.-atom/L.}$ near Faroe to below $0.7 \mu\text{g.-atom/L.}$ near Shetland, and to nearly $1.2 \mu\text{g.-atom/L.}$ in the deepest part of the section along the continental slope.

North Sea oxygen and phosphate determinations in 1949 were restricted, on account of limitation of facilities meantime, to observations in November in respect of east Shetland and western central North Sea waters. In the Shetland area a mean oxygen value of around 5.6 ml./L. within a very narrow range was obtained. Phosphate-phosphorus showed a distribution increasing from just under $0.6 \mu\text{g.-atom/L.}$ in landward waters to over $0.9 \mu\text{g.-atom/L.}$ in more open waters to the eastward.

Farther south, from the latitude of Duncansby Head ($58^{\circ}40' \text{N.}$) to that of Dunbar (56°N.) and west of longitude 1°E. , remarkable constancy in oxygen-content from about

5.2 ml./L. at 50 metres' depth to generally under 5.8 ml./L. on the surface was recorded throughout the area investigated.

No apparent connections are to be deduced so far between oxygen and phosphate distributions, although there is evident in the Faroe-Shetland Channel area, as above indicated, differential distribution in both characters (a)

as between the north and the south of the Wyville Thomson Ridge and (b) between the north-western and south-eastern halves of the Faroe-Shetland section. Comparable data to be collected during 1950 may be anticipated to afford firmer bases for deduction.

J. B. TAIT.

Plankton.

The Continuous Plankton Recorder Survey: Some Broad Changes in the Plankton Round the North of the British Isles in 1949.

These notes are intended to be in continuation of those for 1948 which were included in *Annales Biologiques*, Vol. V. As stated there, the intention is to provide year by year a gross comparison of some of the plankton forms, in the hope that by doing so broad trends or changes in the north-eastern Atlantic and the northern North Sea, and the inter-relationship between the two, may be shown. The summaries take the same form as that used in 1948; histograms showing month by month the average number of any particular organism caught by the Continuous Plankton Recorder, along various steamship routes. The routes are those illustrated in the previous notes, namely, Glasgow — Weather Station "J" (W), Glasgow-Weather Station "I" (X), Leith-Lerwick (A), Leith-Skagerak (K). (Fig. 1). Unfortunately there was no vessel sailing regularly between Pentland and Iceland so there are no data for this line (V) which was included for 1948, but it is hoped that it will become available again in 1950. The averages are based on the total number of individuals caught during the tow divided by the theoretical volume of water that passed through the Recorder, i.e., approximately three cubic metres for each ten miles the machine was towed. It is not suggested that the plankton was consistent throughout each tow; in fact there were generally, as one would expect, well defined patches and density gradients¹⁾, but nevertheless the average provides a useful, if very generalised, measure of the density of the plankton.

The samples were taken at a single depth, 10 metres, and no allowance is made for diurnal migrations but this latter is not such a serious limitation as it might at first appear. Although over the deeper water in the Atlantic it can be shown that larger numbers of some copepods are taken during the hours of darkness, the effect of this is minimised because the tow on both W and X usually took some two days to complete and so always included both day and night samples. In the shallower waters of the North Sea previous evidence¹⁾

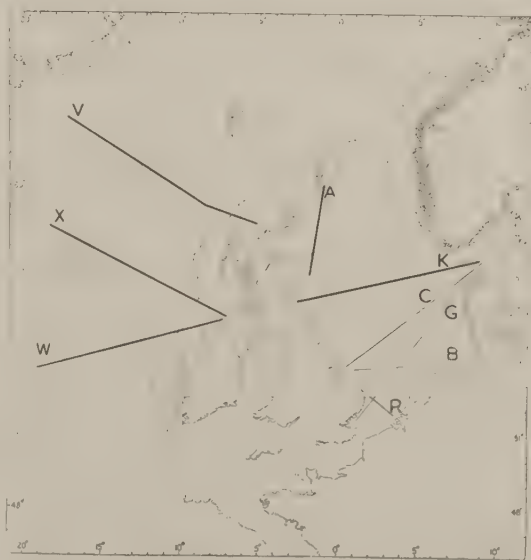


Fig. 1. A chart showing the routes along which the Continuous Plankton Recorder was usually towed monthly in 1949. The routes indicated by the heavier line, i. e. W, X, V, A and K are those selected for this summary. The dotted line marks the position of the 200 fathom contour.

¹⁾ Further details of the catches can be obtained from the Oceanographic Laboratory, 23 Sandport Street, Edinburgh, 6.

¹⁾ Hull Bull. Mar. Ecol. 1,4.

suggests that vertical migration has little effect on the abundance of copepods at 10 metres.

As explained in 1948, the estimates of phytoplankton (Fig. 2) are very approximate and care must be used in interpreting them. They are based on the proportion of the record in any month that fell into various categories of "greenness". It would appear that there was in 1949 as strong a production of phytoplankton sampled on the Atlantic lines as in 1948 and the spring flowering was earlier; *Thalassiothrix*, *Thalassiosira* and *Chaetoceros* were well represented on both W and X by the first week in April, 1949, whereas they had not appeared in appreciable quantities by mid-April, 1948. On the X line in the spring there were denser concentrations—i.e., parts of

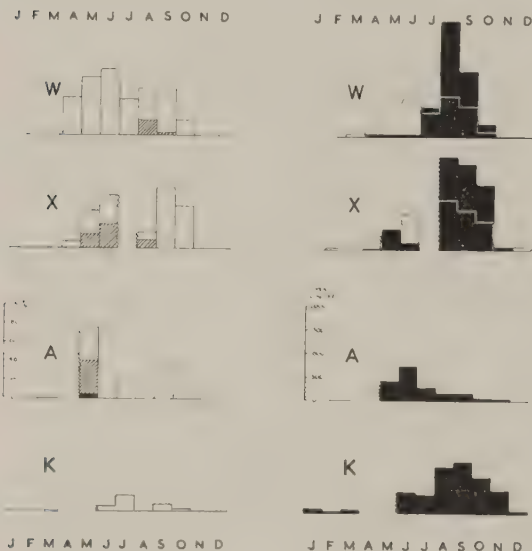


Figure 2

Fig. 2. An estimate of the density of *Phytoplankton* month by month on the recorder lines, W, X, A and K. The histograms show the percentage of the line which sampled water containing various quantities of phytoplankton as estimated by comparing the colour of the filtering silk with an arbitrary colour scale. The open part of the histogram represents »pale green«, the hatched part »green« and the blacked part »dark green«.

Fig. 3. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder lines, W, X, A and K. The values represent the number of copepods per cubic metre either for the whole length of tow on lines A and K or for the two parts of the tow which lie on either side of the 200 fathom contour on lines W and X when the solid histogram shows the numbers over the deeper water and the open histogram those over the shallower or coastal water.

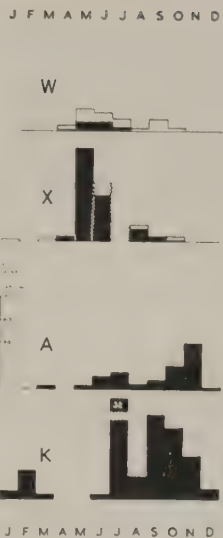


Figure 4

Fig. 4. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder lines, W, X, A and K. Details as in Fig. 3.

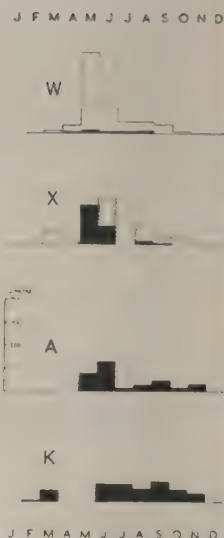


Figure 5

Fig. 5. Histograms representing the relative number of *Calanus* (all stages combined) taken month by month on Recorder lines, W, X, A and K. Details as in Fig. 3.

the filtering silk which were darker green — and on the W line the season of production appeared to extend for a longer period than in 1948. The absence of spring records on the North Sea lines makes it difficult to compare the two years but contrary to the conditions in the Atlantic the spring growth seems to have been later in 1949, as no quantity of phytoplankton was found on either line in March.

Over the deeper waters in the Atlantic the total copepod population (Fig. 3—solid histogram) showed, as in 1948, a well defined maximum in August but the high numbers were maintained longer. Again, there were no large numbers found in the spring but the densities attained in the late summer several hundred miles offshore over the deep water were greater than those ever found over the shallows of the continental plateau; *Acartia* was dominant in this population. To the coastal side of the 200 fathom contour (open histogram) the population was more constant over the summer season, May—September, and so conformed more closely to the conditions expected in the North Sea. The absence of records on A and K make it impossible to

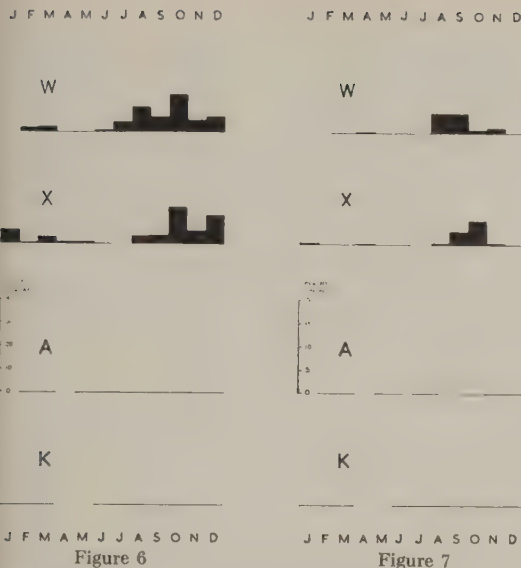


Figure 6

Figure 7

Fig. 6. Histograms representing the relative numbers of *Pleuromamma* spp. taken month by month on Recorder lines, W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on lines W and X. The majority of the copepods are *P. robusta* though a certain number of *P. abdominalis* and *P. gracilis* are included.

Fig. 7. Histograms representing the relative numbers of *Euchaeta* spp. taken month by month on the Recorder lines, W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on lines W and X. By far the majority of the copepods are *E. norvegica* although a few *E. acuta* and *E. hebes* are included.

see if or when the usual spring increase occurred on the North Sea lines but there was the usual sharp increase in numbers during May on a line running from Hull to Copenhagen which is not included in the figure.

The "large *Calanus*" (Fig. 4) comprise adults and stage V whereas "total *Calanus*" (Fig. 5) which are plotted on a scale twenty times smaller can be taken to reflect closely the number of younger stages. The results were essentially the same as in 1948, showing a similar difference between the Atlantic and the North Sea. The coincidence of the larger and smaller stages on the Atlantic line X suggests a single successful breeding period in May and again, as in 1948, there was no sign of the "large *Calanus*" of the next generation which might be expected to have developed in July or August. In the North Sea, however, there was indication of two maxima of "large *Calanus*", one in July and one in late autumn

and there was probably also an earlier one in April or May which was missed through the absence of records. As in the Atlantic, the young stages in the North Sea were probably most abundant in the spring but a difference lies in the fact that in the North Sea high numbers were maintained until late in the year as a result of successive periods of breeding and the spring maximum of young gave rise to the good numbers of large stages in or about August, whereas in the Atlantic there was no sign of this having happened. It is, of course, possible that the Recorder results over the deeper water show only the effect of a seasonal vertical migration rather than a true picture of the density of the population. *Calanus finmarchicus* may behave in the Atlantic in a manner similar to that demonstrated by Sømme (1934)¹⁾ for *C. hyperboreus* in the Norwegian Deep; a mass migration towards the surface for breeding in the spring. Whether this is so should become clear when information from the hauls taken by the Weather Ships while on station is available.

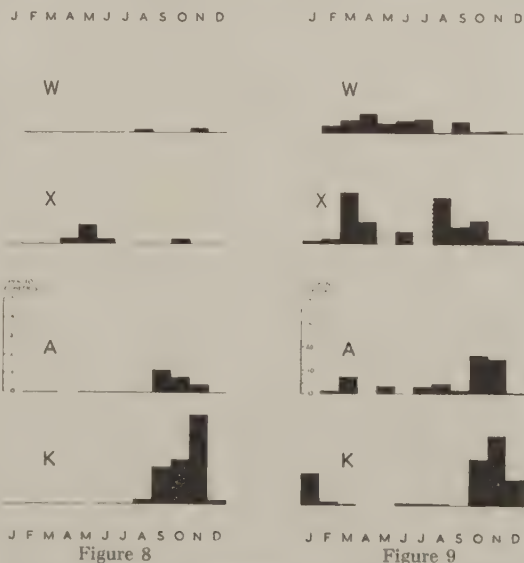


Figure 8

Figure 9

Fig. 8. Histograms representing the relative numbers of *Candacia armata* taken month by month on the Recorder lines W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on lines W and X.

Fig. 9. Histograms representing the relative numbers of *Metridia lucens* taken month by month on the Recorder lines, W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on lines W and X.

¹⁾ Rep. Norweg. Fish. Mar. Invest., IV, No. 9.

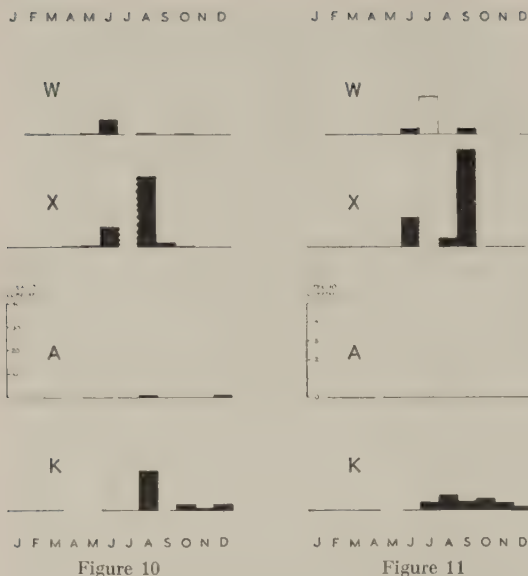


Fig. 10. Histograms representing the relative numbers of *Limacina* (only those individuals larger than 1 mm. included) taken month by month from the Recorder lines, W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on lines W and X.

Fig. 11. Histograms representing the relative numbers of *Clione limacina* (solid) and *Clio clione* (open line) taken month by month on the Recorder lines, W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on lines W and X.

A comparison of 1948 and 1949 in the cases of three of the other four copepod groups, *Pleuromamma* spp., *Euchaeta* spp. and *Metridia lucens*, (Figs. 6—9) brings out well how consistent are the changes in the plankton. These copepods are relatively uncommon and occur in very low numbers in the Recorder catches. Yet their seasonal distribution was remarkably similar in the two years and in the North Sea agreed well with that found in the earlier years for which we have Recorder data. Superimposed on this regularity there are, however, minor differences such as the timing of the arrival of *Candacia* and *Metridia* in the North Sea which appeared to be later in 1949 than 1948.

The pteropods, *Limacina* and *Clione* (Figs. 10 and 11) as in 1948, had later seasons in the North Sea than in the Atlantic and there is some suggestion that their appearance in the North Sea was delayed in 1949 when compared with 1948. Again *Clio* was restricted to the Atlantic and the single month of July.

Tomopteris (Fig. 12) was abundant in the Atlantic in June, 1949 compared with May, 1948 and its appearance in the North Sea in the latter part of the year also seemed later in 1949 than 1948.

Data for the various species of *Sagitta* which were included for 1948 are not yet available.

The warm water copepod, *Rhincalanus nasutus* was far more abundant on the Atlantic lines in 1949 than in 1948. On W it was taken from April to September and was relatively common in June and July, while on X it was found from July to September. It reached the North Sea (A) by September. In 1948, however, it was not found at all on W and only a solitary specimen on X, in May, and although it occurred on the V line in May and October, it was not recorded on the North Sea lines. Looking further back at earlier Recorder results one finds that in 1947 none were found on V, K or A in the summer or autumn. Whereas in 1946 it was taken from July to December on the V line and throughout the same period in the North Sea on A and reached a point further south, on K, in February 1947. There were, of course, no data from W and X until November 1947.

As in 1948, *Doliolum gegenbauri* was found on the Atlantic lines in mid-summer; On W in June and July and on X in June but without the V line it was impossible to trace its movement toward the North Sea.

An overall picture of the plankton suggests that those forms which we have come to consider as "indicators of Atlantic influence" arrived in the North Sea about a month later in 1949 than in 1948. The timing of the appearance of *Candacia*, *Metridia*, *Clione* and *Tomopteris* on A and K supports this view. It is interesting that such a delay in the sequence

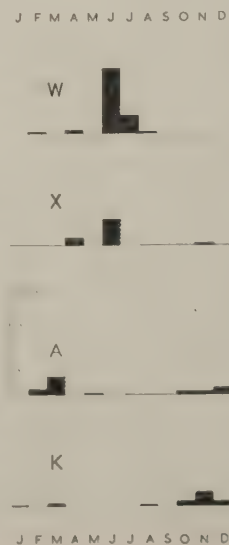


Fig. 12. Histograms representing the relative numbers of *Tomopteris* taken month by month on the Recorder lines, W, X, A and K; only that part of the tow taken outside the 200 fathom contour is included on the lines W and X.

of events conforms with a similar difference in the timing of changes in the indigenous North Sea plankton. In recent years, during the Scottish summer herring fishery, nightly samples of the plankton off Fraserburgh were taken by the fishing fleet using the Hardy Plankton Indicator. In 1948 it was noticed that at the end of June there were a number of synchronous changes in the composition of the plankton. The numbers of *Calanus*, which had been declining for some weeks, reached a very low value and the *Cladocera* disappeared, while at the same time there was a pronounced increase in the numbers of gastropod larvae and the *Ceratia* appeared to increase by many times in a few days. These changes coincided with a marked improvement in the herring catches and it was thought that they might be related to the breaking down of the thermocline by gales which occurred then. In 1949, however, although the *Calanus* population behaved much as in the previous year, the disappearance of the *Cladocera* and the sharp increase in gastropod larvae and the *Ceratia* were again synchronous but occurred at the end of July, one month later, and again better herring catches followed a non-productive period of fishing. An interpretation of this slender evidence might be that some property of the Atlantic water, the movement of which can be detected by the occurrence of the "indicator species", affects the North Sea indigenous plankton and also either directly or indirectly the herring spawning shoals. Clearly confirmatory results from future years will be required before one dare place any significance of facts of this sort which may well be coincidental. But nevertheless it has been noticed for some time past that the southern boundaries of the "indicator species", *Sagitta elegans*, *Candacia armata*, *Metridia lucens*, *Tomopteris* spp., etc., as shown by the Recorder, coincide both in space and time with the expected positions of the herring spawning shoals off the east coast of the British Isles, i. e. off the Firth of Forth in July and August, the Yorkshire coast in September, the East Anglian coast in October and November and towards the mouth of the English Channel in December and January. Again this coincidence may well be fortuitous but it may be worth comment in view of the evidence produced by AASEN¹) that the concentration

of the herring shoals off the Norwegian coast are influenced by the timing and extent of the Atlantic flow. Further consideration will be given to this in a Hull Bulletin now being prepared.

K. M. RAE.

Plankton Investigations from Scottish Research Vessels.

The area covered by the plankton investigations from Scottish research vessels in 1949 was more extensive than in previous years, being carried out from both the "Explorer" and the "Scotia", supplemented by work from the smaller vessels "Kathleen" and "Clupea". Although many investigations were made in areas other than that defined as Northern North Sea, the results are correlated in this report and only brief mention of specific points is made in other area reports. The fish eggs and larval fish are dealt with in a separate report by Mr. SAVILLE.

Collections were made with the International fine silk net and Hensen net hauled vertically and by silk nets 1 metre in diameter towed horizontally or obliquely from deep water. A new net, here termed the "Hensen Minor", was introduced on the "Clupea" to sample the zooplankton population. It is built on the "Hensen" principle, but it is only 14 cm. in diameter at the opening and 20 cm. diameter behind the canvas cone, and it is towed horizontally. The 1 metre nets were used on this ship when sampling for larval herring, etc.

The spring diatom increase in the northern North Sea started about March when *Chaetoceros sociale*, *Rhizosolenia shrubsolei*, *Dactylosolen antarcticus*, and *Bacteriosira fragilis* were the dominant species, lasting until April or even May in the Orkney area. Lack of spring collections off the west side of Scotland prevents assessments of diatoms there but *Chaetoceros sociale* was very abundant off the Hebrides in June and round Faroe in July. The autumn increase was first seen in September and extended into October when *Rhizosolenia shrubsolei* was dominant. Silicoflagellates (chiefly *Dictyocha fibula*) and tintinnids were generally abundant throughout the year. Dinoflagellates, *Ceratium macroceros* in the north-

¹) Communication to the special meeting on herring, Edinburgh, 1949.

east, and a general mixture of species elsewhere, occurred in locally abundant patches, most abundantly in late summer. *Ceratum fusus* was unusually scarce in 1949.

The northern North Sea was very poor in crustaceous plankton in the early months of the year, though there was a general but sparse distribution of *Calanus* in the central North Sea in March and April. By May, however, *Calanus* was found to be very abundant some 60 miles west of Faroe in deep water, although it was scarce round Faroe itself until about July when large quantities were taken there. In June local patches of *Calanus* were found off the entrance to the Faroe Channel and the northern entrance to the Irish Sea. Although in most places *Calanus* was abundant only in the deeper tow nets, in the Firth of Clyde a dense population was found in bright sunshine at the actual surface and was very sparse indeed in the subsurface layers. By September and October *Calanus* had become common east of Shetland and east of Scotland.

The separation of *Calanus finmarchicus* GUNN. from *C. helgolandicus* CLAUS, showed that in open oceanic water *C. helgolandicus* was absent. Where, however, oceanic water became mixed with indigenous water of the Scottish area *C. helgolandicus* was present and was even dominant off the east Scottish coast and in the central North Sea in July and August. The distribution of *C. helgolandicus* is not, however, parallel to *Sagitta elegans*, which is the characteristic indicator species of mixed oceanic and coastal water, as the former was absent in Faroe, Shetland and Orkney where *S. elegans* was present. It is found, however, in the inshore waters of the west Scottish coast such as the Minch, as well as in the North Sea, though *C. finmarchicus* was dominant in the Clyde area.

A population of *Meganyctiphanes norvegica* with *Euchaeta norvegica*, *Heterorhabdus*, *Gaidius*, *Metridia longa*, *Scina borealis* and *Stylocheiron elongatum* was found in January in the Norwegian Deep. Otherwise *Meganyctiphanes* was mostly confined to the Faroe area but entered the North Sea late in the year (October) via the north of Shetland. Later in the year, also, *Limacina retroversa* became very abundant in the Faroe Channel between the Butt of Lewis and Faroe Bank but this species, like *Pelagia* and the doliolids (see below) did not show any real evidence of inflow round the north of Shetland but flooded the Moray Firth

and east Aberdeen-shire coast via the channels south of Fair Isle.

Anomalocera was common at the surface in August in this same area but was not common east of Shetland until October. Decapod larvae (particularly Hyas) were not so abundant in the spring of 1949 as in 1948 but were common later in the year when larvae of *Portunus* and *Munida* occurred commonly in the whole northern region except, again, east of Shetland. Lobster larvae were found in summer months in inshore waters around Scotland and especially in the Orkney area.

Chaetognatha.

During the early months of the year (January, February and March) investigations in the northern area showed widespread distribution of *Sagitta serratodentata* though in no great numbers. It occurred in the North Sea between Fladen and Aberdeen, in the Moray Firth off Orkney and Fair Isle, off Shetland and along a line 61°N. as far east as 3°E. , in the Faroe Channel (i.e., between Faroe and the Butt of Lewis) and around Faroe. Interesting records were taken off the entrance to the Skagerak in January and April at $57^{\circ}30'\text{N.}$, between 5° and 7°E. , although it was apparently absent there in July. It still persisted in most of this northern area when re-investigated in May and June, and was at that time found round Faroe and well off the west Scottish coast as far south as the Irish coast, but was not found in the Minch or other coastal areas. By the late summer it had virtually disappeared from the central North Sea area, though it was still present in the Faroe Channel and it indicated a winter inflow by the north of Shetland route.

S. elegans was present as usual in the area of mixed oceanic and coastal waters, i.e. east of Shetland and Orkney, west of Fladen, off the east Scottish coast, in the Clyde, the northern entrance to the Irish Sea and close to Faroe and Iceland. A few specimens were found in the neighbourhood of St. Kilda in June although it was generally absent in the oceanic water in the Faroe Channel and on the Outer Banks. Like *S. serratodentata* it was found at the entrance to the Skagerak in January and April and was apparently absent there in July. In fact, contrary to the usual records, *S. elegans* was more widely distributed in the central North Sea in spring than in autumn,

when it was concentrated more closely to the east Scottish coast.

S. setosa extended over most of the central North Sea in spring where it was to some extent mixed with *S. elegans*. In June it was found in surface waters over the Norwegian Deep as far as 61°N., i.e. an area to the east of those containing *S. serratodentata*. By the autumn the area of *S. setosa* in the northern and central North Sea had increased with a corresponding decrease in the area of *S. elegans*. *S. setosa* was found abundantly off the Danish and north English coasts and in the Gut. Mixed with *S. elegans* it was present in the Moray Firth and to a lesser extent off Fladen. Records of *S. setosa* of special interest are two from the west Scottish coast, to the south of Barra Head and in the Minch. This appears to be a new area of distribution for this species and although only a few specimens were found they may be of considerable importance. They suggest an outflow from the Irish Sea by the North Channel, carrying with it *S. setosa* which is an indigenous species in the Irish Sea. If this is so, the Irish Sea water would then have become gradually mixed with the oceanic and inshore waters of the west Scottish area, but its presence seems to be indicated as far north as 57°30' in the Minch.

Eukrohnia hamata was present in cold water generally in the Faroe region in March, extending in cold deep water southwards off the west Scottish coast and in the Faroe-Shetland Channel, particularly in June when a slight penetration into the North Sea east of Shetland was noted. In the second half of the year, although present in deep water over the Outer Banks etc., it was comparatively scarce on the southern side of the Faroe Channel and absent in the Shetland area until September.

S. maxima had a similar distribution to *Eukrohnia hamata* but was more widespread over the Outer Banks. It was scarce in the Faroe Channel until September.

S. lyra was not quite so scarce as usual in 1949. It was found off the west Scottish coast and showed a greater penetration into the southern side of the Faroe-Shetland Channel than *S. maxima*, although its numbers on the Banks and off the west Scottish coast generally were considerably smaller than those of *S. maxima*. Specimens were taken in the northern North Sea in June (G 19c and E 21d) and north-west of Shetland in September. It was

absent on the northern side of the Faroe Channel though a few individuals were found north-west of Faroe Bank.

S. planctonis was found more commonly in the 1949 west coast collections than previously, but probably only because new facilities were available for deep water sampling. Its distribution in the area investigated appeared to be confined to deep water off the west Scottish coast and near the Outer Banks and it was found at only one station in the Faroe Channel in July, and one in September. It showed no evidence of penetrating to the Faroe-Shetland area.

S. macrocephala, a deep water species also, was much less common than *S. planctonis* and was found with that species at three stations, WW 18a in April, UU 12a in June and SS 12a in July. *Eukrohnia fowleri* was also found at the second two of these deep water stations.

S. bipunctata was found in 1949, when three specimens were taken off Cape Wrath in February and one off Barra Head in June.

Medusae.

Perhaps not so abundant as in 1946, *Pelagia perla* was again a feature of the 1949 oceanic plankton and it was present north and east of Shetland and Orkney in April and June, but by the late summer its route seemed to be confined to the Orkney Channels. Its general distribution in the northern North Sea was largely confined to the Moray Firth and Aberdeen-shire coast. *Mitrocomella* had a very similar distribution. *Laodicea*, normally a feature of the inflowing oceanic water was not found in 1949 in the Faroe Channel and seemed also to be absent off the west coast of Scotland, being confined to Faroe and the area immediately west and south-west of Faroe. The Faroese waters had dense masses of *Aurelia* and *Cyanea* from July onwards, a feature characteristic also of the inshore waters of the west of Scotland and in the west central North Sea, (i.e. the areas of the greatest numbers of *S. elegans*). *Obelia* medusae, of coastal origin, were present in the coastal areas, particularly around Orkney but were absent on the west side of Faroe, the Outer Isles and Shetland.

Typical of the oceanic plankton were dense masses of *Aglantha*, a race of which was present as usual in the North Sea. A few specimens of *Periphylla hyacintha*, *Haliceas rotundatum* and

Pantachogon rubrum were taken in the deep water nets off the edge of the Continental Shelf; *Chromatonema rubra* was taken midway between Shetland and Norway in June and *Halopsis ocellata* was found at the entrance to the Faroe Channel in July and September. *Staurophora mertensii* was common in Faroe in July. *Eutonina indicans*, often abundant in the indigenous North Sea water, was not common in 1949 but was found off the Aberdeenshire coast in May.

Thaliacea.

As for the past 30 years, *Doliioletta gegenbauri* has been the only doliolid taken by the Scottish research vessels. It occurred in 1949 off the west coast of Scotland in moderate numbers in June and extended round the north coast of Scotland in July and August. It was present in fair numbers in the Orkney area, Moray Firth and Aberdeen coast in August and September, reaching as far south as 56° N. 1° E. in August and October. During the whole of this sequence no specimens were taken on the Outer Banks, none in the northern part of the Faroe Channel, nor around Faroe, nor to the north or east of Shetland.

Salps on the other hand followed quite a different distribution. *Salpa fusiformis* was again taken in 1949 after an apparent absence since 1939, but it was not found in great numbers. It occurred on the Outer Banks in July, though a few had been taken nearer the Scottish coast in June, and it was found to the north and east of Shetland in October, i.e. in the area free from doliolids. Three specimens were found east of the Moray Firth in November. In November two specimens of *Thalia democratica* were taken in the southern side of the Faroe Channel. This appears to be the first time this species has been found in the Scottish area since 1906 though it was abundant there in the years prior to that.

Other Exotic Species.

In 1949 the Scottish vessels were equipped to investigate the plankton in deeper water than previously and samples from depths up to 1400 metres were taken. A large number of bathypelagic species have therefore been recorded from the edge of the Continental Shelf. Very few of these deep water species penetrated with the influx through the Faroe Channel or into inshore areas. The division between plankton entering the Faroe Channel from the south,

i.e. from the Azores area via the west coasts of Ireland and Scotland, and that entering from the open Atlantic west of Faroe, and shown by the differing distribution of the salps and doliolids, is emphasized by the other exotic species. We have two streams, in the middle and late summer at least, each very distinct in itself but mixing along the line of meeting. One is a Lusitanian stream, containing *Doliioletta gegenbauri*, *S. lyra*, *Pelagia perla*, *Mitrocomella*, and the siphonophores *Lensia conoidea*, *Chuniphyes multidentata*, *Vogtia spinosa*, *Praya cymbiformis*, and *Rosacea plicata*, which entered the Faroe Channel at its southern side and penetrated into the North Sea round Orkney. The other is an Atlantic stream, much richer in *Calanus* and other crustacea, and containing also *Salpa fusiformis*, *Clione limacina*, *Dimophyes arctica*, *Agalmopsis elegans*, *Laodicea undulata*, *Staurophora mertensii*, *Sagitta maxima* and *Eukrohnia hamata*. This entered the Faroe Channel at its northern side and penetrated the North Sea via the north of Shetland. Many typical oceanic forms were of course common to both streams, e.g. *Aglantha*, *Clio pyramidata*, *Rhincalanus*, *Eucalanus*, *Thysanoessa longicaudata*, *Sagitta planctonis* and to some extent both *S. lyra* and *S. maxima*. The Lusitanian stream of organisms was recorded somewhat earlier than the western stream and affected the area east of the Moray Firth in August and September, while those entering via the north of Shetland did not arrive until October and November.

Two records of *Muggiæa atlantica* were made in November and December, east of the Pentland Firth and in the Moray Firth. These are believed to be the first Scottish records of a species which is quite common in the English Channel. Apart from the normal distribution of cold water species in the greater depths, there were rather fewer cold water species being brought into the Scottish area generally in 1949 than in previous years. *Calanus hyperboreus* was unusually poorly represented, even in deep water off the west Scottish coast, but it occurred round Faroe in May with a slight extension into the Faroe Channel in late summer and autumn. It was present as usual in the Norwegian Deep.

The spring evidence shows an unusual picture of the northern North Sea in that water of oceanic origin carrying *Rhincalanus*, *Thysanoessa longicaudata*, *Sagitta serratodentata* and *S. elegans* flooded the area, even penetrat-

ing towards the entrance to the Skagerak, while in the later part of the year the oceanic water was more confined to the western side of the North Sea as shown then by distribution of *Dolioletta gegenbauri*, *Thysanoessa longicauda*, Rhincalanus, Clione and *Sagitta elegans*.

Amongst the exotic larval fish taken were *Melamphaes beanii* from deep water in July and records were made of *Fierasfer* east of Orkney in October and near Fair Isle in November. *Myctophum glaciale* was very common both in larval and post-larval stages at almost all the deep water stations sampled during the summer. Other exotic fish larvae found in deep water stations included *Argyropelecus*, *Cyclothone*, *Lampanyctus*, *Stomias*, *Paralepis* and *Bathylagus*.

A list, with positions and dates of records, of the more unusual exotic species is given in a separate contribution below.

J. H. FRASER.

List of Rare Exotic Species found in the Plankton by the Scottish Research Vessels in 1949.

This list excludes commonly occurring exotic species, even although they may be of great value as "indicators"; it also excludes species occurring rarely in 1949 but which have been found commonly in recent years. *Lensia conoidea* which was included in previous lists has been excluded for 1949 owing to its abundance over almost all the oceanic area from March to November. *Salpa fusiformis* has been included as it has been found again after an absence of a number of years.

Species marked * were not recorded in 1947 or 1948. The list is more extensive this year because additional equipment has enabled the vessels to sample plankton from much deeper water than previously.

	Position		Date
	N. Lat.	W. Long.	
Siphonophora:			
<i>Dimophyes arctica</i>	59°17'	6°53'	30.4
	62°04'	10°48'	9.5
	58°49'	9°26'	20.5
	56°50'	9°50'	3.6
	56°50'	9°30'	4.6
		E. Long.	
	58°29'	4°29'	10.6
		W. Long.	
	56°52'	12°00'	12.7

	Position		Date
	N. Lat.	W. Long.	
	57°08'	13°00'	12.7
	57°30'	13°42'	12.7
	59°19'	13°14'	13.7
	59°46'	12°47'	13.7
	60°37'	11°20'	14.7
	60°20'	5°50'	30.7
	59°31'	7°05'	3.9
	60°12'	7°40'	4.9
	60°54'	8°16'	4.9
<i>Galetta australis</i>	56°08'	9°00'	11.7
<i>Chuniphyes multidentata</i>			
	58°49'	9°26'	20.5
	56°50'	9°50'	3.6
	59°46'	12°47'	13.7
<i>Muggiaea atlantica</i>	57°46'	2°29'	16.11
	58°44'	2°41'	11.12
<i>Hippopodius hippopus</i>	58°49'	9°26'	20.5
	59°10'	7°45'	1.6
	60°56'	1°00'	24.11
<i>Praya cymbiformis</i>	56°50'	9°30'	4.6
<i>Rosacea plicata</i>	56°50'	9°30'	4.6
<i>Vogtia spinosa</i>	56°50'	9°50'	3.6
	56°50'	9°30'	4.6
	59°31'	7°05'	3.9
Medusae:			
<i>Halopsis ocellata</i>	61°22'	0°05'	23.6
	60°18'	12°20'	14.7
	60°31'	11°58'	14.7
	61°02'	7°50'	15.7
		E. Long.	
<i>Nausithoë punctata</i>	55°32'	6°42'	26.1
		W. Long.	
	56°52'	12°00'	12.7
<i>Rhopalonema velatum</i>	56°50'	9°30'	4.6
	56°52'	12°00'	12.7
<i>Periphylla hyacintha</i> *	62°04'	10°48'	9.5
	58°49'	9°25'	20.5
	56°50'	9°30'	4.6
	56°22'	10°00'	11.7
	59°46'	12°47'	13.7
<i>Pantachogon rubrum</i> *	59°10'	6°45'	1.6
	56°22'	10°00'	11.7
	56°52'	12°00'	12.7
	59°46'	12°47'	13.7
<i>Halicreas</i> spp.*	58°40'	8°55'	1.6
	57°35'	9°10'	3.6
	56°50'	9°50'	3.6
	56°50'	9°30'	4.6
	56°22'	10°00'	11.7
	56°52'	12°00'	12.7
	59°31'	7°05'	3.9
<i>Chromatonema rubrum</i> *	59°10'	7°45'	1.6

	Position		Date		Position		Date
	N. Lat.	W. Long.			N. Lat.	W. Long.	
Polychaeta:				<i>Gaidius tenuispinus</i> *	62°04'	10°48'	9.5
<i>Vanadis formosa</i>	56°50'	9°50'	3.6		58°40'	8°55'	1.6
	56°50'	9°30'	4.6		56°50'	9°30'	4.6
	56°52'	12°00'	12.7			E. Long.	
	57°08'	13°00'	12.7		58°29'	4°29'	10.6
<i>Lagisea hubrecti</i> *	58°49'	9°26'	20.5		61°01'	3°30'	22.6
	59°10'	7°45'	1.6			W. Long.	
	56°22'	10°00'	11.6		56°22'	10°00'	11.7
	56°52'	12°00'	12.7		59°46'	12°47'	13.7
	59°46'	12°47'	13.7		60°37'	11°20'	14.7
<i>Travisiopsis lobifera</i> *	58°40'	8°55'	1.6		63°30'	6°35'	22.7
	56°52'	12°00'	12.7	<i>Gaidius brevispinus</i> *	59°50'	11°21'	20.5
Chaetognatha:				<i>Gaetanus kruppi</i> *	59°44'	7°15'	30.4
<i>Sagitta planctonis</i>	59°44'	7°15'	30.4		62°04'	10°48'	9.5
	62°04'	10°48'	9.5		58°49'	9°26'	20.5
	59°10'	7°45'	1.6		59°10'	7°45'	1.6
	58°40'	8°55'	1.6		56°50'	9°50'	3.6
	58°11'	9°24'	2.6		56°50'	9°30'	4.6
	58°12'	8°45'	2.6		56°22'	10°00'	11.7
	56°50'	9°30'	4.6		56°52'	12°00'	12.7
	56°52'	12°00'	12.7		59°46'	12°47'	13.7
	57°08'	13°00'	12.7		60°18'	12°20'	14.7
	59°19'	13°14'	13.7	<i>Gaetanus miles</i> *	57°35'	9°45'	3.6
	49°46'	12°47'	13.7	<i>Gaetanus pileatus</i> *	59°44'	7°15'	30.4
	60°37'	11°20'	14.7		62°04'	10°48'	9.5
	60°00'	5°25'	30.7		59°10'	7°45'	1.6
	60°23½'	7°49½'	12.11		58°40'	8°55'	1.6
<i>Sagitta bipunctata</i> *	58°50'	6°26'	2.3		56°50'	9°50'	3.6
	56°50'	9°50'	3.6		56°50'	9°30'	4.6
<i>S. macrocephala</i> *	59°44'	7°15'	30.4		56°22'	10°00'	11.7
	56°50'	9°50'	3.6		56°52'	12°00'	12.7
	56°52'	12°00'	12.7		59°46'	12°47'	13.7
<i>Eukrohnia fowleri</i> *	56°50'	9°50'	3.6		60°37'	11°20'	14.7
	56°52'	12°00'	12.7		59°31'	7°05'	3.9
Nemertina:				<i>Euchirella bitumida</i> *	56°50'	9°50'	3.6
<i>Nectonemertes</i>					60°12'	7°40'	4.9
<i>mirabilis</i> *	56°50'	9°50'	3.6	<i>E. curticaudata</i>	58°49'	9°26'	20.5
					59°10'	7°45'	1.6
Cephalopoda:					56°50'	9°50'	3.6
<i>Taonidium pfefferi</i> *	57°08'	13°00'	12.7		56°50'	9°30'	4.6
	60°37'	11°20'	14.7		56°22'	10°00'	11.7
<i>Desmoteuthis</i>					56°52'	12°00'	12.7
<i>hyperborea</i> *	56°22'	10°00'	11.7		60°37'	11°20'	14.7
	60°18'	12°20'	14.7		59°31'	7°05'	12.11
Copepoda:				<i>Euchirella maxima</i> *	59°44'	7°15'	30.4
<i>Megacalanus</i>					56°50'	9°50'	3.6
<i>longicornis</i> *	58°04'	8°00'	21.5		56°50'	9°30'	4.6
<i>M. princeps</i> *	56°50'	9°50'	3.6	<i>Euchirella</i>			
<i>Bathycalanus</i>				<i>messinensis</i> *	61°49'	5°21'	9.3
<i>richardi</i> *	56°22'	10°00'	11.7		56°50'	9°30'	4.6
<i>Spinocalanus magnus</i> *	59°46'	12°47'	13.7		56°52'	12°00'	12.7
<i>Actidiopsis armatus</i> *	58°49'	9°26'	20.5	<i>Euchirella truncata</i>	56°50'	9°30'	4.6
<i>Chiridius obtusifrons</i> *	62°04'	10°48'	9.5		59°31'	7°05'	3.9

	Position		Date		Position		Date
	N. Lat.	W. Long.			N. Lat.	W. Long.	
<i>Pseudochirella</i>				<i>Heterostylites</i>			
<i>pustulifera</i> *	56°50'	9°50'	3.6	<i>longicornis</i>	61°21'	3°10'	9.3
<i>Pareuchaeta hansenii</i> *	56°50'	9°30'	4.6		58°40'	8°55'	1.6
	56°22'	10°00'	11.7		56°50'	9°30'	4.6
	56°52'	12°00'	12.7		56°22'	10°00'	11.7
<i>Pareuchaeta scotti</i> *	56°50'	9°50'	3.6		56°52'	12°00'	12.7
<i>Pareuchaeta sarsi</i> *	56°50'	9°50'	3.6		59°46'	12°47'	13.7
<i>Undeuchaeta plumosa</i>	56°50'	9°30'	4.6	<i>Augaptilus</i>			
	56°22'	10°00'	11.7	<i>megalaureus</i>	58°49'	9°26'	20.5
<i>Undeuchaeta major</i>	56°22'	10°00'	11.7		56°50'	9°30'	4.6
<i>Valdiviella insignis</i> *	56°50'	9°50'	3.6		59°31'	7°05'	3.9
<i>Chirundina streetsi</i>	56°22'	10°00'	11.7		60°12'	7°40'	4.9
<i>Xanthocalanus</i>				<i>Euaugaptilus filiger</i> *	56°52'	12°00'	12.7
<i>propinquus</i>	59°44'	7°15'	30.4		59°46'	12°47'	13.7
<i>Orchocalanus</i>				<i>E. laticeps</i> *	56°22'	10°00'	11.7
<i>trigoniciceps</i> *	59°44'	7°15'	30.4	<i>E. oblongus</i> *	59°44'	7°15'	30.4
	56°50'	9°30'	4.6	<i>Centraugaptilus</i>			
<i>O. cristatus</i> *	59°46'	12°47'	13.7	<i>ratrayi</i>	56°50'	9°30'	4.6
<i>Cornucalanus</i>					59°19'	13°14'	13.7
<i>chelifer</i> *	56°50'	9°50'	3.6	<i>C. horridus</i> *	56°52'	12°00'	12.7
	56°50'	9°30'	4.6	<i>Arietellus plumifer</i>	56°52'	12°00'	12.7
<i>Scottocalanus</i>					59°46'	12°47'	13.7
<i>persecans</i> *	56°50'	9°50'	3.6		60°37'	11°20'	14.7
	56°50'	9°30'	4.6	<i>Pontoptilus muticus</i> *	56°50'	9°30'	4.6
	56°22'	10°00'	11.7		56°22'	10°00'	11.7
<i>S. securifrons</i>	59°17'	6°53'	3.3		59°46'	12°47'	13.7
	62°04'	10°48'	9.3	<i>Pontoptilus robustus</i> *	59°44'	7°15'	30.4
	58°40'	8°55'	1.6		56°22'	10°00'	11.7
	56°50'	9°50'	3.6		56°52'	12°00'	12.7
	56°50'	9°30'	4.6	<i>Paraugaptilus</i>			
	56°22'	10°00'	11.7	<i>buchani</i> *	56°50'	9°30'	4.6
	60°00'	5°25'	30.7	Ostracoda:			
<i>Lophothrix latipes</i> *	60°12'	7°40'	4.9	<i>Gigantocypris</i>			
<i>Lophothrix frontalis</i> *	56°50'	9°50'	3.6	<i>mulleri</i>	59°50'	9°30'	4.6
	56°50'	9°30'	4.6			E. Long.	
	56°22'	10°00'	11.7	<i>Conchoecia haddonii</i>	57°43'	6°50'	27.1
	56°52'	12°00'	12.7			W. Long.	
	60°37'	11°20'	14.7		58°40'	8°55'	1.6
<i>Scaphocalanus</i>					56°50'	9°50'	3.6
<i>magnus</i> *	56°52'	12°00'	12.7		59°50'	9°30'	4.6
<i>Amallothrix</i>				<i>Conchoecia imbricata</i>	58°49'	9°26'	20.5
<i>emarginata</i> *	58°49'	9°26'	20.5	<i>Conchoecia elegans</i>	62°04'	10°48'	9.5
	56°50'	9°30'	4.6		56°22'	10°00'	11.7
	56°22'	10°00'	11.7	<i>Conchoecia borealis</i>	59°44'	7°15'	30.4
<i>Amallothrix gracilis</i> *	56°52'	12°00'	12.7		62°04'	10°48'	9.5
<i>Amallothrix arcuata</i> *	59°46'	12°47'	13.7		56°50'	9°50'	3.6
<i>Metridia princeps</i> *	58°49'	9°26'	20.5		56°22'	10°00'	11.7
	56°50'	9°30'	4.6		59°46'	12°47'	13.1
	59°46'	12°47'	13.7		59°31'	7°05'	3.9
<i>Hemirhabdus grimaldii</i>	56°50'	9°50'	3.6	<i>C. daphnoides</i>	56°50'	9°30'	4.6
<i>Pleuromamma xiphias</i>	56°50'	9°30'	4.6		56°22'	10°00'	11.7
<i>Heterostylites</i>		E. Long.			56°52'	12°00'	12.7
<i>longicornis</i>	57°43'	6°50'	27.1				
	58°29'	4°29'	10.6				

	Position		Date		Position		Date
	N. Lat.	W. Long.			N. Lat.	W. Long.	
Amphipoda:							
<i>Cyphocaris anonyx</i> *	56°22'	10°00'	11.7				
	56°52'	12°00'	12.7				
	59°46'	12°47'	13.7				
<i>Brachyscelus</i>							
<i>crusculum</i>	56°50'	9°50'	3.6				
	56°50'	9°30'	4.6				
		E. Long.					
<i>Scina borealis</i> *	57°43'	6°50'	27.1				
	58°29'	4°29'	10.6				
		W. Long.					
	62°04'	10°48'	9.5				
	56°50'	9°30'	4.6				
	56°52'	12°00'	12.7				
<i>Scina oedicarpus</i> *	56°50'	9°30'	4.6				
<i>Scina submarginata</i> *	56°50'	9°30'	4.6				
<i>Parascina fowleri</i> *	58°49'	9°26'	20.5				
<i>Lanceola loveni</i> *	56°52'	12°00'	12.7				
<i>Phronima sedentaria</i> *	59°42'	2°17'	14.9				
<i>Mimonectes</i>							
<i>steenstrupi</i> *	56°50'	9°30'	4.6				
<i>Thamneus</i>							
<i>platyrrhynchus</i> *	58°50'	6°26'	2.3				
<i>Primno macropus</i> *	56°50'	9°50'	3.6				
Isopoda:							
<i>Zenobiana prismatica</i> *	60°51'	9°06'	15.7				
<i>Munnopsis murrayi</i>	59°44'	7°15'	30.4				
	56°50'	9°50'	3.6				
	56°22'	10°00'	11.7				
	56°52'	12°00'	12.7				
	59°46'	12°47'	13.7				
<i>Munnopsis oceanica</i>	56°50'	9°30'	4.6				
Euphausiacea:							
<i>Thysanopoda</i>							
<i>acutifrons</i> *	56°52'	12°00'	12.7				
<i>Euphausia krohni</i>	59°17'	6°53'	3.3				
	61°08'	2°10'	10.3				
	59°17'	6°53'	30.4				
	56°50'	9°50'	3.6				
	60°45'	2°06'	11.9				
		E. Long.					
<i>Stylocheiron</i>	57°25'	6°32'	27.1				
<i>elongatum</i>		W. Long.					
	56°52'	12°00'	12.7				
<i>S. longicorne</i>	60°07'	2°17'	10.3				
	59°33.3'	1°59'	15.3				
		E. Long.					
	61°01'	1°00'	22.6				
		W. Long.					
	60°00'	5°25'	30.7				
Mysidacea:							
<i>Gnathophausia zoea</i> *	56°22'	10°00'	11.7				
<i>Eucopeia unguiculata</i> *	57°30'	13°42'	12.7				
Decapod Larvae:							
<i>Gennados parvus</i> *	58°49'	9°26'	20.5				
	56°50'	9°50'	3.6				
	56°22'	10°00'	11.7				
	56°52'	12°00'	12.7				
	59°46'	12°47'	13.7				
	60°37'	11°20'	14.7				
Pteropoda:							
<i>Clio cuspidata</i>	56°50'	9°30'	4.6				
	56°22'	10°00'	11.7				
	56°52'	12°00'	12.7				
	59°31'	7°05'	12.11				
	61°08'	2°10'	23.11				
<i>Diacria trispinosa</i>	59°46'	12°47'	13.7				
<i>Pneumodermopsis</i>							
<i>ciliata</i>	59°32'	1°21'	31.8				
	60°12'	2°10'	11.9				
	59°33'18"	1°59'	14.9				
Tunicata:							
<i>Salpa fusiformis</i>	58°11'	9°24'	2.6				
	56°50'	9°50'	3.6				
	56°50'	9°30'	4.6				
	56°50'	9°02'	4.6				
	56°50'	8°07'	4.6				
	59°46'	12°47'	13.7				
	59°04'	2°05'	28.10				
	59°32'	1°10'	28.10				
		E. Long.					
	61°01'	2°30'	29.10				
	61°01'	2°00'	29.10				
	58°06'	0°39'	25.11				
		W. Long.					
	60°43'	0°39'	30.10				
	57°46'	2°29'	16.11				
	58°34'	0°41'	24.11				
<i>Thalia democratica</i> *	59°31'	7°05'	12.11				
Fish Larvae:							
<i>Argyropelecus</i>							
<i>hemigymnus</i> *	57°35'	9°45'	3.6				
	56°50'	9°50'	3.6				
<i>Bathylagus benedicti</i>	59°10'	7°45'	1.6				
	58°40'	8°55'	1.6				
	58°11'	9°24'	2.6				
	58°12'	8°45'	2.6				
	57°35'	9°45'	3.6				
	56°50'	9°50'	3.6				
	56°50'	9°30'	4.6				
	56°50'	9°02'	4.6				

N. North Sea
Plankton, Eggs and Larvae

	Position		Date
	N. Lat.	W. Long.	
<i>Cyclothone microdon</i> *	59°44'	7°15'	30.4
	57°35'	9°45'	3.6
	56°50'	9°50'	3.6
	56°50'	9°30'	4.6
	56°22'	10°00'	11.7
	56°52'	12°00'	12.7
	59°46'	12°47'	13.7
	60°38'	10°30'	14.7
<i>Fierasfer</i> sp.	59°04'	2°05'	28.10
	59°30'	1°33'	28.11
<i>Paralepis borealis</i>	61°01'	1°00'	9.3
	60°17'	3°57'	8.5
	59°20'	10°20'	20.5
	56°50'	9°30'	4.6
	56°50'	9°02'	4.6
<i>Melamphaes beani</i> *	56°52'	12°00'	12.7

	Position		Date
	N. Lat.	W. Long.	
<i>Myctophum</i>	59°17'	6°53'	30.4
<i>punctatum</i> *	62°02'	9°18'	5.9
<i>Nansenia</i>	56°50'	9°50'	3.6
<i>groenlandica</i>	56°50'	9°30'	4.6
<i>Stomias boa</i>	59°10'	6°55'	1.6
	58°40'	8°55'	1.6
	58°11'	9°24'	2.6
	58°12'	8°45'	2.6
	57°35'	9°10'	3.6
	57°35'	9°45'	3.6
	56°50'	9°50'	3.6
	56°50'	9°30'	4.6
	60°37'	11°20'	14.7
<i>Lampanyctus</i>			
<i>elongatus</i> *	59°17'	6°53'	30.4
	57°35'	9°10'	3.6

J. H. FRASER.

THE FISH

Fish Eggs and Larvae in Scottish Waters.

A more detailed analysis of the Scottish larval fish data for the years 1938 to 1948 has revealed misleading weaknesses in the more precise assessments of annual brood values previously published. A major source of error has been due to the unavoidable change from cheese-cloth to stramin nets in the post-war period. This has resulted in a marked paucity of larvae under 10 mm. in length in the post-war records — presumably due to escape of the smaller sizes through the larger mesh of the post-war nets. Accordingly, it has been decided to discontinue these precise assessments for the present, and to limit comment on the 1949 collections to general statements of the distribution and abundance of the more interesting species.

Haddock.

Haddock eggs were taken from January to April. The January cruise was confined to the central waters of the North Sea and resulted in the capture of eggs in small numbers in the Gut and over the Fisher Bank. The distribution of larvae in subsequent months would suggest that the January spawning was of

little importance. By March, spawning had reached its peak, with eggs generally distributed over the whole of the northern North Sea. Major concentrations occurred over Smiths Bank, in the Long Forties, to the west of Shetland, and over and to the north of the Patch. The distribution of eggs in April was broadly similar with some diminution in numbers over the whole area.

Haddock larvae were very scarce in March and April, although no larvae greater than 10 mm. long were taken, so that the apparent scarcity may be misleading. The greatest concentration was recorded off the Butt of Lewis in April. By May, larvae up to 25 mm. in size were widespread in the Fair Isle passage, to the west of Orkney, and in the Moray Firth and Long Forties regions. In June, fish of a similar size distribution were taken along the north Scottish coast and to the north and east of Shetland. The absence of haddock larvae of a greater size than 25 mm. is a constant feature of the 1 metre collections from Scottish waters in the years 1938—49. Similar collections from Faroe waters on the other hand frequently contain fish of a much larger size in June and July.

Any estimation of the overall abundance of the 1949 haddock larvae compared with that of other years must be treated with considerable caution. The indications are that they were similar to the numbers in 1948, less abundant than in 1938, but more so than in 1939 and 1947.

Cod.

Larval cod were markedly scarce throughout the year in the collections from the North Sea. The first larvae were taken in March, to the north of Shetland, in the Fair Isle region, and over the Viking Bank and the North West Flat. They were absent from the intervening area and from the Moray Firth. By April, cod larvae had spread into the Moray Firth and were widespread in the central North Sea. In May they were still present around Orkney and in the Moray Firth but absent to the east of this.

Saithe.

Saithe larvae were quite abundant in the 1949 collections. Their distribution was very similar to that of the cod larvae, apart from the fact that they did not show the same gap between the eastern and western distributions in March.

Whiting.

Whiting larvae were first taken in March over the North West Flat, but in this month and in April they were very scarce and localised in distribution. By May they were more widespread and abundant, occurring along the North Scottish coast, in the Fair Isle region and in the Moray Firth. In June, they were sparse on the west coast and absent from the north coast, but widespread within the northern North Sea as far east as the edge of the Norwegian Deep. By July and August they had disappeared from these northern waters, but were widespread in the central North Sea south of the latitude of Aberdeen.

Ling.

A noticeable feature of the 1949 collections from the North Sea has been the abundance and widespread distribution of larval ling. The densest concentrations of these occurred north and east of Shetland in June, but they were

also widespread in the Moray Firth from May to August and occurred south of the Viking Bank and east of Ling Bank in June. They were considerably more abundant than in 1939, apparently the most productive of the previous years for which data are available, and had an earlier occurrence and a more southerly and easterly extension of distribution than in that year. In contrast to the abundance of the larvae of this fish, their eggs were extremely scarce in the Scottish collections. They were taken on the Viking Bank area in March, and at the Butt of Lewis in April-May, but only in very small numbers.

Hake.

The distribution of hake larvae in 1949 was of the normal pattern for Scottish waters, with the greatest numbers on the north Scottish coast and in the Moray Firth in August and September. The abundance of these larvae was similar to that of 1948 and considerably less than in 1946 and 1947.

Lemon Sole.

Lemon sole larvae appeared in greatest numbers from May to August, although isolated specimens were taken into November. They had a markedly western distribution throughout the year, very few being captured east of the prime meridian. The densest concentrations occurred north of Orkney in May, in the Moray Firth in May, June and more particularly in July, and off the Firth of Tay in August. The indications are that 1949 was a reasonably successful brood year for this species—inferior only to 1939 of the previous years for which we have comparable data.

Mackerel.

The main spawning area of the mackerel was traversed in June and July, when the density of eggs was very markedly less than in 1948. (FRASER and SAVILLE, 1950, Ann. Biol., V). The greatest concentrations in the Norwegian Deep were again on the south-western edge, where the 100 and 200 metre contours are closely apposed, but the highest number of eggs taken at a station in 1949 did not exceed 1,000. Mackerel eggs were also taken in small numbers all along the line 61°01'N., with one concentration of 500 to the north of the eastern

end of this line on the edge of the 200 metre contour. There were also small concentrations in the Fair Isle and outer Moray Firth region in June. In July, mackerel eggs were taken in numbers exceeding 1,000 per station along the outer Moray Firth on the edge of the 100 metre contour, and were generally distributed in numbers of less than 50 per station in the central North Sea. Mackerel eggs were also taken in small numbers on the Scottish north and west coasts in May and June.

Considerably greater numbers of mackerel larvae were present in the collections in 1949 than in 1947 which was considered a good brood year for mackerel (FRASER, 1949, Ann. Biol., IV) but, as the areas surveyed were rather different and the surveys were carried out in different months, no strict comparison can be made between the two years. Within the North Sea, larvae were first taken in June along the line 61°01'N. from Flugga eastwards over the Norwegian Deep, to the east of Shetland, off Fair Isle and to the east of Orkney. They were absent in June in the southern part of the Norwegian Deep and in the outer Moray Firth. By July they were widespread in the central North Sea with concentrations of more than 50 larvae per station in the Longstone area, at the Tail End of the Dogger and on the North West Flat. They were also present in small numbers east of Orkney but were absent from the outer Moray Firth. In August they were taken at several stations in the Moray Firth and along the Scottish east coast in numbers of less than 30 per station.

On the north and west Scottish coasts mackerel larvae were fairly widespread in June, concentrations of more than 50 per station being found in the vicinity of North Rona, immediately west of Tiree and off the north Irish coast.

A. SAVILLE.

Haddock.

Scottish Investigations.

Population census data were collected throughout 1949, as in previous years, from the trawling surveys carried out in the North Sea by the research vessel "Explorer". The area covered in this survey extended from approximately latitude 55° in the south to 61° in the north, and included the grounds upon

which the main North Sea haddock fishery was concentrated.

Sampling was effected as usual by means of a covered otter trawl, with which one-hour hauls were made at scattered points throughout the area. In the spring months sampling was concentrated mainly on the northern grounds, where the fishery at this time was located, and in the autumn months it was principally on the central North Sea grounds. All haddock caught were measured and scale samples were taken for subsequent age analysis.

Age Composition of the Stock.

As in 1948¹⁾ the results of the age analysis of the samples collected during the year have been considered for six different regions of the North Sea; namely, the northern, north-central, central and western areas, and the Moray Firth and Firth of Forth. Sampling was of a very low intensity in the Moray Firth and Firth of Forth, however, so that results from these areas are not contained in this report.

The age compositions of the catches from the four main areas, which constitute the most important haddock trawling grounds, are presented in Table 1 (a—d). These give the average catch per 10 hours fishing in quarterly periods and for the whole year.

The stock sampled in 1949 was composed, as in 1948, almost entirely of fish less than six years of age. In all areas, fish older than five years of age, which have been recorded as one group, made up less than 2% of the total catch. Their greatest numbers were found in the deep northern and north-western areas, but here they constituted a very small part of the total number of fish caught.

The 1948 brood, in its second year of life, was mostly below the minimum marketable limit of 11 inches throughout the greater part of the sampling area during the year, and constituted the upgrowing recruitment brood. It did however, appear in the commercial landings in the autumn fishery off the Scottish east coast. The northern spring fishery, in contrast, was based mainly on fish between two and six years of age.

The age-groups between two and six years

¹⁾ B. B. PARRISH — Haddock — Northern North Sea. Ann. Biol., Vol. V, 1950.

Table 1. Age Composition of Haddock caught by "Explorer" in 1949 per 10 hours trawling.

a) Northern Area						b) North Central Area					
Month:	Jan.— March	April— June	July— Sept. 4 ¹⁾	Oct.— Dec.	All Months 37	Jan.— March 8 ¹⁾	April— June 22	July— Sept. 10	Oct.— Dec. 13	All Months 53	Age
Hours trawling: 12											
Year-Class											
1948	123	787	798	No Sampling	572	136	437	339	566	405	1
1947	358	289	360.		319	125	95	59	38	79	2
1946	88	29	48		50	45	10	6	4	14	3
1945	725	333	665		496	336	116	66	69	128	4
1944	73	49	48		56	95	22	10	7	27	5
1943	18	17	12		17	18	3	2	0	5	6
and older											and older
All Ages	1385	1504	1931		1510	755	683	482	684	658	
c) Central North Sea						d) Western Area					
Hours trawling:		4 ¹⁾	17	24	45		3 ¹⁾	10		13	
Year-Class											
1948	No Sampling	2447	1695	1860	1850	No Sampling	20	150	No Sampling	120	1
1947		130	92	55	76		440	202		257	2
1946		8	6	3	5		26	6		11	3
1945		60	99	35	62		983	286		446	4
1944		28	15	4	10		160	13		47	5
1943		23	11	2	7		20	2		6	6
and older											and older
All Ages		2696	1918	1959	2010		1649	659		887	

¹⁾ Sampling too limited to be representative of whole area.

of age were most densely populated in the northern region. The 1945 brood made up approximately 50% by number of the marketable fish present on these grounds and contributed in greatest measure to the commercial landings. Its greatest abundance was found on the grounds to the east of the Shetlands, where a mean annual yield of 50 fish per hour was obtained. In the central area the yield from this age-group was much less, averaging 7 fish per hour.

The 1946 group was found in very small numbers from all areas, the results showing, as in previous years, the very poor recruitment level for this brood. The largest numbers were caught in the northern area, but here the yield was no greater than 5 fish per hour. In the central area the catch averaged less than one fish per hour.

The 1947 brood also had a predominantly northerly and north-westerly distribution, catches from these regions being approximately four times greater than those from the shallower grounds to the south. In all areas however, the numbers caught were small compared with previously productive broods.

Unlike the older age-groups, the 1948 brood had a predominantly southerly distribution. Catches of up to 600 fish per hour were obtained from the central area, with dense con-

centrations being obtained from the tail end of the Dogger Bank, the Great Fisher Bank, the Gut and the Scottish east coast grounds. The mean density in this area was over three times greater than on the northern grounds. Local dense concentrations were also obtained from the east Shetland grounds. It is probable that the shoals found on the southern grounds were derived from the main North Sea spawning concentrations, whereas the shoals to the east of the Shetlands originated largely from spawners in the western area.

The 1949 brood, in its first year of life, first appeared in the research vessel catches in July, and was retained in the small meshed cover in the subsequent months. Its distribution and density have been determined for

Table 2. Distribution and Density of the 1949 Brood in its 1st Year of Life.

Region	August—December		
	Number caught	Hours fishing	Number p. 10 hours
Northern	186	4 ¹⁾	465
North Central	877	17	516
Central	560	27	207
Western	56	10	56

¹⁾ Sampling too limited to be representative of whole area.

Table 3. Mean Lengths of each Age-Group caught by "Explorer" in North Sea Regions during 1949.

Year Class	Age	Months	NORTHERN AREA			NORTH CENTRAL AREA			CENTRAL AREA			WESTERN AREA		
			No. of Fish	Range	Mean Length	No. of Fish	Range	Mean Length	No. of Fish	Range	Mean Length	No. of Fish	Range	Mean Length
1949	0	Jan.-Mar.	—	—	—	—	—	—	—	—	—	—	—	—
		Ap.-June	—	—	—	—	—	—	—	—	—	—	—	—
		July-Sept.	186	10—16	12.3	—	9—17	13.8	—	—	—	56	8—14	10.0
		Oct.-Dec.	—	—	—	—	11—20	15.2	—	10—20	15.4	—	—	—
1948	1	Jan.-Mar.	147	13—20	16.0	109	14—17	17.1	—	—	—	—	—	—
		Ap.-June	1652	14—24	19.8	963	15—25	19.6	979	15—29	21.1	6	16—20	18.1
		July-Sept.	319	19—27	23.0	339	18—30	23.4	2882	18—33	25.8	150	22—42	26.3
		Oct.-Dec.	—	—	—	736	20—36	24.7	4465	20—37	27.6	—	—	—
1947	2	Jan.-Mar.	429	21—36	26.0	100	22—35	27.0	—	—	—	—	—	—
		Ap.-June	607	21—35	27.4	210	24—37	28.6	52	25—34	28.8	132	23—36	26.5
		July-Sept.	144	26—36	30.5	59	29—38	32.8	157	28—42	34.1	198	27—40	32.8
		Oct.-Dec.	—	—	—	50	28—37	31.9	134	32—42	36.0	—	—	—
1946	3	Jan.-Mar.	106	25—38	29.3	36	26—38	30.5	—	—	—	—	—	—
		Ap.-June	60	27—38	31.5	22	26—35	31.4	3	29—38	31.9	8	28—33	30.3
		July-Sept.	19	31—40	35.6	6	32—37	35.2	11	34—46	38.4	6	31—44	35.2
		Oct.-Dec.	—	—	—	5	30—40	34.8	8	36—46	39.6	—	—	—
1945	4	Jan.-Mar.	870	25—46	31.6	269	27—49	32.8	—	—	—	—	—	—
		Ap.-June	699	26—47	33.1	256	27—46	33.2	24	31—44	36.0	295	27—44	33.9
		July-Sept.	266	29—45	36.3	66	33—57	40.3	169	31—50	41.0	286	29—49	40.0
		Oct.-Dec.	—	—	—	89	30—58	37.1	84	36—52	42.6	—	—	—
1944	5	Jan.-Mar.	87	32—58	39.9	76	31—58	39.7	—	—	—	—	—	—
		Ap.-June	102	32—48	39.5	49	31—50	41.3	11	36—47	40.0	48	34—46	38.9
		July-Sept.	19	38—50	44.8	10	42—59	47.5	25	35—58	46.5	13	35—49	42.5
		Oct.-Dec.	—	—	—	9	38—60	46.6	10	44—58	52.5	—	—	—
1943	6	Jan.-Mar.	17	36—53	46.1	7	39—55	46.9	—	—	—	—	—	—
		Ap.-June	24	40—57	45.4	2	49—51	50.0	6	41—51	44.8	6	49—54	51.0
		July-Sept.	4	43—46	44.0	2	56—60	58.0	11	49—74	52.5	2	44—45	44.5
		Oct.-Dec.	—	—	—	—	—	—	5	50—57	53.6	—	—	—

the four main areas for the period August—December. These results are recorded in Table 2.

The preliminary estimates of the abundance of this age-group indicate that it is of greater numerical strength than the 1946 and 1947 broods in their first years of life, and may be gauged as of "average" strength.

Size Composition and Growth.

The mean sizes of the age-groups comprising the catches from the different areas have been determined from the length and age frequency distributions of the catches. These figures are given in Table 3 together with the number of fish measured and the range in length for the six youngest broods in each quarterly period.

As in 1948, the mean lengths of all of the

age-groups considered were greater in the catches from the central area than in those from the deep-water grounds. By the end of the year, the mean lengths of the 1948 brood was approximately 3 centimetres greater in the central area than in the northern and north central areas. At this time a large proportion of this brood in the central area had reached the minimum marketable limit of 11 inches (28 cm.), and therefore predominated in the landings from the autumn east coast fishery. In the north, however, only a small proportion of the largest members of the brood were of marketable size by the end of the year, so that the landings from these grounds were composed mainly of the older broods.

The results contained in Table 3 are being used in an investigation of the growth rates of the post-war haddock stock and the regional differences encountered.

Rates of Mortality of North Sea Haddock Stock.

Since 1946, the surveys of the haddock populations by "Explorer" have provided data from which the rates of decrease in numbers of the constituent age-groups may be ascertained. The age-groups for which the most extensive data are available for this analysis are those spawned in 1944 and 1945. For these two broods, the means of the logarithms of the catches in each statistical square in the haddock area have been determined for each quarterly period in which sampling was carried out during the years 1946—1949. The best estimate of the rates of decrease of log number has been determined for these broods by standard regression methods.

In each case the observed decrease of log number was linear, so that the relationship between the number of fish caught per hour, and passage of time can be expressed in the form:

$$Y = Ae^{-bt} \text{ where } Y = \text{number of fish,} \\ t = \text{time, } b = \text{coefficient of decrease,} \\ \text{and } A \text{ is a constant.}$$

The mean logarithms and the regression coefficients determined from them, together with their standard errors are given in Table 4, and the values are plotted in Fig. 13, in which the individual regression lines have been drawn.

The difference between the regression coefficients, -0.097 and -0.128 for the 1945 and 1944 broods respectively have been tested for significance, and it is found that it is likely to be attributed to sampling variations. A pooled estimate has therefore been calculated for the

two age-groups, for which a value of -0.112 has been obtained.

The instantaneous (k) and total annual (a) mortality rates can be readily determined from the regression coefficient obtained from the pooled data. These values are 1.03 (on a yearly basis) and 64% respectively. This latter figure represents the mean total annual mortality rate to which the fishable stock has been subjected during the period 1946—1949. No subdivision into fishing and natural mortality rates is possible from these data.

The Commercial Fishery.

The landings of haddock from the North Sea by British trawlers have been determined, as in 1948, for the northern, central and southern regions, from the monthly landing charts produced by the Ministry of Agriculture and Fisheries.

The total catch, hours fishing and catch per 100 hours fishing have been determined for each quarter of 1949 for each area separately, and for all areas, and these are presented, together with the corresponding results for 1947 and 1948, in Table 5.

The landings from all areas of the North Sea were less during 1949 than 1948, except in the central and southern areas in October—December, while a corresponding decline in the catch per unit of effort was experienced in all but the northern area in the period April—June and the southern area in the autumn months. The landing from the fishery during

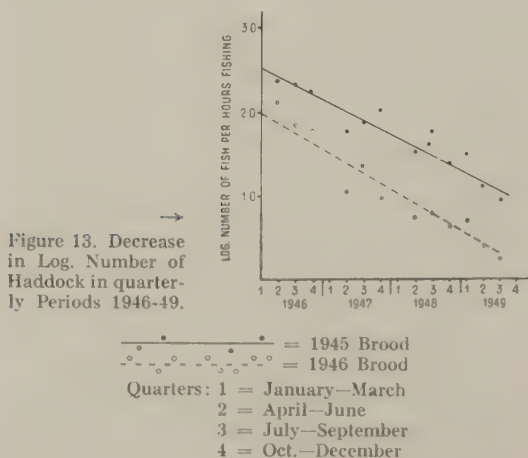


Table 4. Mean Logarithms and Regression Coefficients 1945 and 1944 Broods.

	1946		1947	
	1945 Brood	1944 Brood	1945 Brood	1944 Brood
Jan.—March	—	—	—	—
April—June	2.353	2.088	1.761	1.054
July—Sept.	2.308	1.837	1.849	1.335
Oct.—Dec.	2.258	1.760	2.001	0.936
	1948		1949	
	1945 Brood	1944 Brood	1945 Brood	1944 Brood
Jan.—March	—	—	1.492	0.695
April—June	1.505	0.731	1.147	0.414
July—Sept.	1.762	0.785	0.946	0.270
Oct.—Dec.	1.392	0.642	¹⁾	¹⁾
Regression coefficient	-0.097	-0.112		
Standard Error	0.011	0.012		

¹⁾ Sampling not representative.

Table 5. Landings of Haddock from North Sea Regions in 1947, 1948 and 1949.

Quarterly Period	Year	North of Latitude 57°30' N.			Latitude 55° N. to 57°30' N.		
		Wt. landed in 100 cwts.	100 hrs. fishing	Wt. landed per 100 hrs.	Wt. landed in 100 cwts.	100 hrs. fishing	Wt. landed pr. 100 hrs.
January to March.	1947	798	424	188.2	242	211	115.0
	1948	943	611	154.4	179	211	84.9
	1949	481	466	103.3	106	254	41.8
April to June.	1947	547	440	124.0	482	522	92.3
	1948	749	708	105.7	208	438	47.4
	1949	579	480	120.7	114	575	19.8
July to September.	1947	177	226	78.3	965	833	117.3
	1948	179	336	53.4	1025	927	109.9
	1949	162	420	38.6	914	995	91.8
October to December.	1947	892	378	235.9	2203	934	230.9
	1948	1161	752	154.4	872	626	139.3
	1949	615	541	113.7	1033	835	123.7
Quarterly Period	Year	South of Latitude 55° N.			All areas ¹⁾		
		Wt. landed in 100 cwts.	100 hrs. fishing	Wt. landed per 100 hrs.	Wt. landed in 100 cwts.	100 hrs. fishing	Wt. landed per 100 hrs.
January to March.	1947	16	1309	1.2	1282	2061	62.2
	1948	20	1830	1.1	1382	2819	49.0
	1949	8	1707	0.5	750	2211	33.9
April to June.	1947	86	1449	6.0	1305	2594	50.3
	1948	48	1307	3.7	1351	2684	50.3
	1949	15	1027	1.5	856	2231	38.4
July to September.	1947	292	1556	18.8	1733	2842	61.0
	1948	205	1314	15.5	1607	2820	57.0
	1949	113	1391	8.1	1361	3085	44.1
October to December.	1947	426	1712	24.9	3989	3230	123.5
	1948	140	1564	8.9	2556	3315	77.1
	1949	144	1577	9.1	2140	3269	65.5

¹⁾ Contains landings from unknown rectangles.

the January—March period on the northern grounds was approximately at the rate of 1 cwt. per hour's fishing in 1949 as against 1.5 and 1.9 cwts. in 1948 and 1947, respectively. The 1949 figure was in fact lower than the 1938 level, when the values for the periods January to March and April to June were 1.1 cwts. and 1.3 cwts. respectively. Comparative figures for the autumn fishery show a marked fall in landing per unit effort in northern and central area during the period 1947—49, although in the southern area the quantity for 1949 was very slightly greater than that for 1948.

Summary.

The following main features of the haddock stock in the North Sea are established from the 1949 research vessel survey.

(1) The stocks in all parts of the North Sea were composed almost entirely of fish less than 6 years of age. Of these, the commercial fishery was based mainly on fish older than

two years of age, except in the central area where the 1948 brood contributed to the autumn fishery.

(2) Of the older age-groups the 1945 brood was the most abundant in all regions of the North Sea, its greatest density appearing in the deep-water areas to the north. In these regions it made up 50% of the marketable catch.

(3) The 1946 and 1947 broods were below average numerical strength for two and three year old fish in all areas, to which can be attributed the overall decline in the haddock fishery during the post-war years.

(4) The 1948 brood was caught in larger numbers than either of the two previous recruitment broods. Its centre of greatest density was in the central area where, by virtue of its rapid growth, it appeared in the commercial landings in the autumn months.

(5) The total annual mortality rate for the post-war haddock stock is estimated to be approximately 64%.

(6) The North Sea haddock fishery in 1949 showed a decline in total yield and in catch per

unit of effort, and reached a level approximately equal to that obtained in the pre-war years.

B. B. PARRISH. W. MAIN.

Whiting.

Analysis of British Statistics.

Introduction.

As part of a detailed investigation into the biology of the whiting in the North Sea, an analysis of the statistics of the British North Sea whiting fishery has been undertaken to gauge the trends in the yield and density of the whiting stock during the pre-war, wartime and post-war periods. This report deals with some preliminary results.

Detailed statistics of the yield, intensity of fishing and landing per unit of effort for British trawlers from different parts of the North Sea are available for the pre-war years up to 1938 and for the post-war years after 1946. These are contained in the statistical charts issued by the Ministry of Agriculture and Fisheries, and have been utilised in this analysis. For the wartime period, however, no detailed data are available, so that total landings only can be used, as contained in the Sea Fisheries Statistical Tables of the Ministry of Agriculture and Fisheries.

Pre-war Landings by British Vessels.

In view of the regional differences in the weight of whiting landed, the data have been determined for three regions of the North Sea, namely: the northern (latitude $57^{\circ}30'N.$ to $62^{\circ}N.$), central ($55^{\circ}N.$ — $57^{\circ}30'N.$) and southern (south of $55^{\circ}N.$). In the first of these areas, trawling is carried out predominantly by Scottish trawlers during the first half of the year when the fishery is principally a roundfish one. The second is where the Scottish and English trawlers show the greatest overlap in their areas of exploitation, but in which the Scottish vessels concentrate in the autumn months. The third is exploited principally by English trawlers, fishing for flatfish, and is seldom visited by Scottish ones.

The total weight landed, the hours' fishing, and the weight landed per 100 hours' fishing, has been determined for each of these areas for the period 1923—38. These are given in Table 6, whilst the landings per 100 hours' fishing are plotted in Figure 14.

Table 6 and Figure 14 show that the landings fluctuate annually, although they show no general upward or downward trend during this period. As the intensity of fishing over this period was fairly constant (Table 6) there would seem to have been a fairly stable whiting stock before the war, with annual differences, probably chiefly due to brood fluctuations.

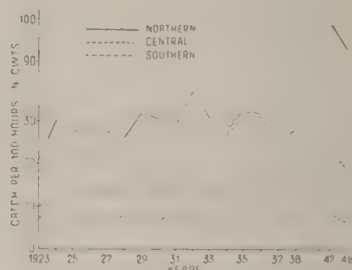


Figure 14. Mean Catch per 100' hours fishing of British Steam Trawlers from the North Sea, 1923—38 and 1947—48.

It will be seen from Table 6 that the yield of whiting and catch per unit of effort were greater in the northern area than in the south. More than half the total weight landed during this pre-war period came from the grounds to the north of latitude $57^{\circ}30'N.$, and the yield per unit of effort was greatest from these grounds in all years. The ratios of the catch per 100 hours' fishing from the northern, central and southern areas during the years 1923—38 were 4:2:1. The weighted mean of the total North Sea landings per 100 hours' during the pre-war period was found almost to coincide with that of the central area.

Yet these figures are misleading as estimates of the whiting stocks because the bulk of the fish from the southern half of the north sea as mentioned earlier, was landed by English trawlers, many of which use gear adapted particularly for catching flatfish, whereas the Scottish vessels, fishing chiefly in the northern North Sea, use a roundfish gear. The difference in catching capacities for whiting of those two gears is demonstrated by results obtained during comparative trawling experiments between the English and Scottish research vessels, using flatfish and roundfish gears respectively, (PARRISH, 1949 and MARGETTS 1949). This shows that the roundfish net caught significantly greater numbers of whiting than the flatfish one so that the apparent density of whiting stock

Table 6. British Steam Trawler Landings from the North Sea, 1923-38.

Year	REGIONS OF THE NORTH SEA			Total North Sea
	Northern	Central	Southern	
1923	54	128	108	318
1924	164	92	109	411
1925	110	89	88	320
1926	89	98	91	305
1927	131	106	85	354
1928	144	97	88	364
1929	198	108	105	457
1930	169	88	91	391
1931	151	98	103	398
1932	217	101	91	461
1933	185	82	78	285
1934	189	103	65	401
1935	233	131	60	482
1936	188	84	53	374
1937	125	54	64	273
1938	155	81	68	337
Total	2501	1542	1346	5931
Total Number of Hours' Fishing (000 omitted)				
1923	263	1274	1459	2808
1924	544	698	1236	2729
1925	398	821	1259	2706
1926	308	697	1028	2199
1927	474	818	1170	2612
1928	552	748	1105	2581
1929	619	670	1145	2608
1930	541	680	1247	2649
1931	522	591	1154	2435
1932	573	564	1029	2323
1933	589	677	1180	2608
1934	672	663	1189	2711
1935	703	629	1107	2630
1936	581	599	1113	2476
1937	489	556	1037	2231
1938	545	456	821	1956
Total	8369	11,141	18,289	40,262
Catch of Whiting per 100 Hours' Fishing				
1923	20.3	10.0	7.4	11.3
1924	30.1	13.1	8.7	15.0
1925	27.6	10.8	7.0	11.8
1926	28.8	13.9	8.8	13.8
1927	27.7	13.0	7.2	13.5
1928	26.0	12.9	7.9	14.1
1929	31.9	16.1	9.1	17.5
1930	31.1	12.8	7.3	14.7
1931	28.8	16.6	8.8	16.3
1932	37.7	17.9	8.8	19.8
1933	31.3	12.0	6.6	10.9
1934	28.0	15.5	5.5	14.7
1935	33.1	20.8	5.3	18.3
1936	32.3	13.9	4.7	15.1
1937	25.6	9.7	6.1	12.2
1938	28.4	17.9	8.3	17.2
Weighted Mean	29.9	13.8	7.3	14.7

in the southern North Sea, as recorded by normal commercial statistics, may be too low relative to the central and northern areas.

It is not yet possible to apply corrections to the commercial data, although appropriate

experiments are proceeding. There is reason to believe however, that this factor might appreciably affect the ratios between the landings from the northern, central and southern areas.

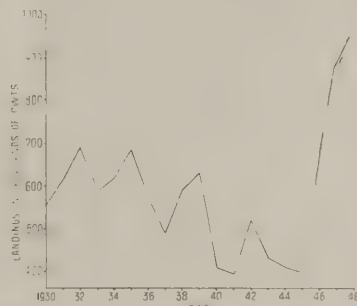


Figure 15. Total Whiting Landings in Britain, by all Types of British Vessels, from all Fishing Grounds, 1930-48.

Table 7. Total Whiting Landings in Britain, by all Types of British Vessels, from all Fishing Grounds, 1930-48, in 1000 cwt's.

Pre-war										Mean
1930	1931	1932	1933	1934	1935	1936	1937	1938	1930-38	
553	617	691	587	619	683	572	487	590	600	
Wartime										Mean
1939	1940	1941	1942	1943	1944	1945	1939-45			
633	407	395	521	432	411	399	457			
Post-war										Mean
1946	1947	1948	1946-48							
658	873	946	826							

Wartime Landings by British Vessels from all Grounds.

As mentioned previously, no detailed British steam trawler landing records are available in a suitable form for the war years, but Table 7, and Figures 15 and 16 (which include seine-net landings), indicate the trends in the British fishery for whiting during the war. As a high percentage of the total whiting landings in Britain comes from the North Sea, the conclusions drawn from Table 7 and Figures 15 and 16 are considered to be fairly true also of the North Sea fishery.

Table 7 and Figure 15 show that during the war there was a reduction of about 23% from the pre-war landings in mean weight, but this quantity was caught by a very much reduced fleet of vessels. Therefore the mean catch per unit of effort was probably greater during the war than before.

During the war the fishing was not only largely restricted to the inshore fishing boats, with a very much reduced fleet of trawlers fishing near the coasts but, under the wartime conditions of scarcity, the whiting became more valuable and may have been more especially sought than before.

Figure 16 shows that the percentage of whiting in the total demersal landings increased during the war, due partly to this increased value and also to the fact that whiting are relatively denser inshore than other demersal species and therefore better represented in the catches of inshore fishing boats than these other commercial species. It will be noted that this percentage increase occurred despite the percentage decrease in the total landings.

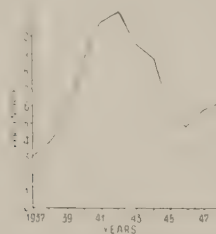


Figure 16. Percentages of Whiting in Total Demersal Landings, by all Types of British Vessels, from all Fishing Grounds 1937—48.

Post-war Landings of British Vessels.

There was quite a marked post war rise in total landings, (Table 7 and Figure 15) and in catch per unit of effort (Tables 6 and 8 and Figure 14). The post war rise in mean catch per unit of effort in the North Sea was chiefly due to a rise in the northern area.

MARGETTS and HOLT (1947), discussing the

effect of the war on the English trawl fisheries, found no marked increase in the post-war landings of whiting by English trawlers. From the results presented here this would seem to be true only of the southern North Sea, which is the area chiefly exploited by the English vessels.

Tables 6 and 8, and Figure 14, indicate that there was a disproportionate rise after the war in the whiting catch per unit of effort of the trawlers fishing in the north, central and southern North Sea. This changed from a pre-war ratio, of about 4:2:1 respectively, in weight, to 12:3:1, post-war. While the investigation of this problem is continuing, some unpublished observations on the life history of the fish may partially explain the great increase in the north.

The records of the Scottish research vessel "Explorer" show a northerly and offshore migration from the coastal and shallow southern North Sea areas to the deeper northern basin, with age, similar to that which has been found in the haddock (THOMPSON, 1927). With the wartime reduction of fishing of the offshore stocks, the older, larger, fish might reasonably be expected to be collecting in the north, while the smaller sizes would still be exploited in the coastal waters. Whilst this is being checked by means of an age/size analysis of stocks, it is believed to have played some part in this disproportionate change. However it will be noticed that such a result as this, even if so caused, cannot easily be distinguished from the effects of a wartime rest after differential fishing intensity. If there had been too intensive fishing in the north as compared with the south, then the post-war improvement in the north might have been disproportionately large. At the same time, the proportion of large fish would be expected to have increased. See Table 7, and Figures 15 and 16, with the earlier discussion on the wartime whiting fishery show that, while the whiting was less intensively fished during the war than before, this reduction was not so great as with other demersal species, so that the post-war increase in yield would not be expected to be as great as with these other demersal species. It is in fact, difficult to believe that the whiting was overfished before the war, (see Figure 14), and it is rather difficult to account satisfactorily for this striking change in proportion, unless northerly migration of large fish is postulated, so that this is perhaps an example in which the

Table 8. British Steam Trawler Landings of Whiting from the North Sea.

		North	Central	South	Total North Sea
Total Whi- ting in (000 cwt.)	1947	153	68	53	313
	1948	224	54	40	377
	Total	377	122	93	690
Total hours Fishing (000 omitted)	1947	153	282	605	1074
	1948	241	280	598	1164
	Total	394	562	1,202	2,238
Catch per 100 hours	1947	100.0	24.1	8.7	29.1
	1948	93.0	19.3	6.7	32.3
	Weighted Mean	95.7	21.7	7.7	30.8

migration factor should be considered to play a serious part in the fishing equation.

We must, however, also allow for (1) the differential efficiency of the northern and southern trawls with respect of the whiting and other roundfish, which must help to account for the very small post-war increase in the south, and (2) the increased demand for whiting as food during and after the war, which may well have been more effective in northern waters owing to the fact that the men fishing in the northern North Sea are more concerned with roundfish and have designed their gear to catch them.

Another factor of unknown importance may lie in the tendency to discard fish of little commercial value. Before the war whiting drew relatively poor prices, compared with haddock, etc., but during and since the war, prices have improved relatively owing to the demand for edible fish of all kinds, so that fish which may once have been caught and discarded may have come to have a better chance of being landed.

It is probable that there was an increase in natural mortality of the whiting during the war due to an increase in number of its predators, e.g. cod, but the influence of this feature on post-war landings cannot be estimated.

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ROBERT W. ELLIS.

Plaice.

Preliminary Survey.

A beginning has been made with the examination of the post-war plaice records collected in the east coast of Scotland bays by the M. V.

"Kathleen". A preliminary survey of the 1949 material has revealed some general features of the situation.

In the Moray Firth bays, where dense populations have been found in the post-war years, recruitment was good in 1945, 1947 and 1948 while it was definitely poorer in 1946.

In St. Andrew's Bay, on the other hand, the 1946 brood has proved to be the most numerous of those represented, whilst in 1947 and 1948 recruitment was apparently relatively poor.

In Aberdeen Bay, which supports the best growth of all the east coast bays, and from which plaice are accordingly more rapidly fished out, the 1948 brood was well represented.

A rapid examination has also been made of the size composition of the plaice stocks in St. Andrew's Bay and the Firth of Forth in the post-war period (1947—1949), when local by-laws were not being enforced and fishing by seine net was virtually unrestricted, in order to obtain a comparison with the pre-war years, 1937—39, when seining was forbidden in the northern half of the Firth of Forth.

It appears that in St. Andrew's Bay a slight improvement has occurred in the size composition during 1947—49. This may possibly be due either to a tendency for seiners to fish further afield, thus permitting better survival in the bay, or to better growth as a result of thinner stocks.

In the Firth of Forth, however, the size composition has altered considerably between the two periods. The unrestricted fishing has been associated with a reduction in the numbers of adult fish or of fish approaching the adult stage, as the following figures for all fish over 20 cm. in length will show.

	Firth of Forth		Largo Bay	
	1937—39	1947—49	1937—39	1947—49
Median	27.7	24.5	28.2	24.1
Lower quartile	24.0	22.3	25.1	22.2
Upper quartile	31.7	27.4	31.5	26.0

As may be expected the greatest decrease is in the numbers of the large fish. That this change is probably due to fishing in the northern half of the Forth is seen from the above comparable figures for Largo Bay, the principal plaice grounds in the northern half.

Once again the reduction of the upper quartile, in this case by 5.5 cm. suggests the heavy toll which has been taken of large fish since pre-war years, but the fall in both medi-

ans and lower quartile also show that large numbers of adolescent fish have been removed from the stocks.

BENNET B. RAE.

Halibut.

North Sea Statistics, 1930—47.

From the Scottish statistics of halibut landed at Aberdeen, calculations can be made of the catch per unit of effort—per 100 hours fishing for trawlers and per 100 lines for liners. These figures give an estimation of the fluctuations in density of the stock in the North Sea from year to year.

Aberdeen trawlers fished in the North Sea throughout all the war years although the area open to fishing was restricted. The catch per 100 hours (Fig. 17, Table 9) from 1930 to 1947 shows that considerable fluctuations took place. Peaks are evident however in 1941 and again 1945, after which the level remained considerably higher than that of pre-war years.

No long lining was carried on by Aberdeen vessels in the North Sea from 1940 to 1944. In the period before the war, the catch per 100 lines (Fig. 18, Table 9) showed slight irregular fluctuations, but no definite trend, the annual mean being 6.7 cwts. When fishing was resumed in 1945 however, the catch per 100 lines rose to 54.2 cwts.—an increase of 500% on the highest pre-war figure. The high values for 1945—47 show what order of figures is possible, and demonstrates how insignificant are the pre-war fluctuations.

The increases in stock recorded above resemble similar fluctuations which took place on grounds outside the North Sea. In the case

of these grounds (Faroe, Iceland and Western Grounds, see Report for North Western Area) it was possible to link the trawl increases in the early 1940's with those of the liners several years later, and to suggest that they were the outcome of a good brood year about 1937. In the North Sea, however, a similar correlation of trawler and liner catches cannot be made, since the line fishery was in abeyance for five years during the war. Nevertheless, it seems reasonable to assume that while the great increase in catch per 100 lines in the North Sea from 1945 onwards (Fig. 18) could be accounted for either by the effects of the war-time reduction in fishing or by increased recruitment due to good brood years, it is more probably due to a combination of both these factors.

A. D. McINTYRE.

Sprat.

Norwegian Investigations.

Investigations concerning the age, growth, and number of vertebrae have been continued. An analysis has been made of the vertebral counts from the years 1927—1949. The material, which comprises 94 samples each of about 100 specimens or more, will be dealt with in detail in a special publication in the series "Report on Norwegian Fishery and Marine Investigations".

The present material confirms the previous observations that, within samples of the 0-group, the larger fish will generally have a somewhat higher number of vertebrae than the smaller ones. Each sample has been divided into two sub-groups, "large" and "small", ac-

FIGURE 17. Trawlers Catch per 100 Hrs

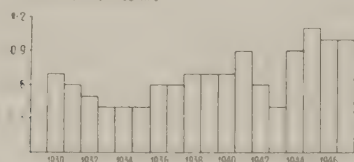


FIGURE 18. Liners Catch per 100 Lines



Figures 17 and 18. North Sea. Catch per unit of effort. British trawlers and liners (Aberdeen) 1930—48.

Table 9. British Vessels Landing at Aberdeen.

Catch of halibut per 100 hours (trawlers) and per 100 lines (liners) in cwts. from North Sea grounds. (1930—47).

Vessel	Year	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947
Trawlers		0.7	0.6	0.5	0.4	0.4	0.4	0.6	0.6	0.7	0.7	0.7	0.9	0.6	0.4	0.9	1.1	1.0	1.0
Liners		9.8	6.1	6.6	4.9	5.7	4.1	5.9	9.1	7.2	9.2	—	—	—	—	—	54.2	38.8	26.7

Table 10. Sprat of the 0-Group.

Distribution of Samples according to Difference (D) between average Number of Vertebrae of "large" and "small" Fish of the same Sample.

D	Number of samples
+0.80—.89	1
0.70—.79	—
0.60—.69	1
0.50—.59	—
0.40—.49	3
0.30—.39	8
0.20—.29	14
0.10—.19	22
+0.00—.09	14
—0.00—.09	3
0.10—.19	2
0.20—.29	3
0.30—.39	—
—0.40—.49	1

according to the average size of the fish. Table 10 shows the distribution of the samples according to the difference in the average number of vertebrae between "large" and "small" fish of the same sample. A positive difference indicates that the larger fish had a greater number of vertebrae than the smaller ones.

If the number of vertebrae was independent of the size of the fish, one should expect an equal number of positive and negative differences. Actually, there are 63 positive differences and 9 negative differences. This is a significant deviation from expectation. It will appear that the positive differences between the two sub-groups of the same sample are generally smaller than 0.40.

The fact that there is generally a positive correlation between the size of the fish and the number of vertebrae, makes the analysis of

Table 11. Vertebral Counts of Sprat from Norwegian Waters during 1927 to 1949.

Distribution of Samples according to Average Number of Vertebrae.

Average Number of Vertebrae.	Number of samples
48.70—.79	1
.60—.69	1
.50—.59	—
.40—.49	—
.30—.39	1
.20—.29	4
.10—.19	7
48.00—.09	20
47.90—.99	21
.80—.89	22
.70—.79	11
.60—.69	3
.50—.59	2
47.40—.49	1

the samples rather complicated. The sprat generally occur in shoals, and fish of approximately the same size have a tendency to keep together. As to the size of the fish, our samples may well be representative of the shoals from which they are taken. It may be doubtful, however, whether a single shoal, in the same way, is representative of the total stock in a certain locality, and unless the samples are representative as to the size of the fish, we cannot expect them to be representative as to the number of vertebrae.

The average values for number of vertebrae of sprat from Norwegian waters range from 47.40 to 48.70, generally lying between 47.70 and 48.20. Table 11 gives a summary of the results.

GUNNAR DANNEVIG.

Southern North Sea.

INTRODUCTION.

BYOND the results available in the present contributions, the year 1949 witnessed an extension of the Committee's work on the plaice due to the participation of the new Dutch research ship "Antoni van Leeuwenhoek" and to an appraisal of the Flamborough spawning ground by an English research ship. Whilst the Dutch investigations allowed some headway to be made in studies on the drift of eggs and larvae from the main plaice spawning grounds, the existence of dangerous areas due to mines along the continental coast continues not only to impose a limitation of our activities in this direction, but makes it impossible to carry out a census of the remaining important plaice spawning ground of the southern North Sea, which is situated in the neighbourhood of Heligoland. A study of the pilchard spawning grounds and shoaling occurrence in the English Channel was undertaken by England during the year, but this also has not yet reached the stage at which the observations are available for publication.

It will be seen from the contributions that it has been found possible to give some attention to two species not previously mentioned in the *Annales*—the whiting, and the black sea-bream. This is due to the renewed and welcome activities in the North Sea and English Channel of the French Research ship "Président Théodore Tissier".

Environment.

Hydrography. Surface salinities and temperatures from the Hull-Hanstholm steamship route for the years 1947, 48 and 49, indicate that water of more than 35‰ appeared on this line only in 1949, when it occurred in June and July in the central part. Summer temperatures were higher in 1949 than 1948

but the highest reading was in September 1947 when in Lat. 50°22' N. Long. 07°00' E., a value of 21.5°C. was obtained. On the Flamborough Line of stations, salinities tended to increase from 1946 to 1949.

In anticipation of a resumption of continuous current measurements from Lightvessels in the southern North Sea situated at places of considerable biological significance, observations from the Varne and neighbouring ships between 1938 and 1940 and from the Maas, Terschelling, North Hinder and Haaks Lightvessels in 1939 and 1940 are presented this year for the first time.

Plankton. Observations from the Flamborough Line of stations, while showing comparable values for zooplankton to those found in pre-war days, gave substantially lower values for phytoplankton. Between 1946 and 1949 there was a tendency for the phytoplankton to recover and Mr. CATTLEY points out that the phytoplankton standing crop densities followed roughly the changes of the salinity in the same period. The dry-weights of Hensen hauls from the Flamborough Line in 1949 were substantially above the two previous years, where 1947 was slightly higher than 1948. The fat-content did not follow the dry-weight, 1948 being the best year followed by 1949 and then 1947. For an area off the N.E. coast of England sampled by the Hensen net each June, the dry-weight was highest in 1947 and least in 1948, the fat-content declining steadily from 1947 to 1949.

Fish Species.

The Demersal Catch. The catch per eight-day fishing trip made by Grimsby North Sea trawlers in 1949 are shown to have been only a little below those of 1948 and still substantially above 1938, the last pre-war year. Dutch

figures also indicated a decrease in the catch per day's absence compared with 1949. An apparent increase in the catch per day's absence towards the end of the year was shown to be due to the increased fishing power of trawlers. When standard ships were compared it was seen that the decline had continued. The decrease was less for cutters than trawlers.

Cod. The landings of cod reported from Holland together with the catch per day's absence remained at much the same level as in 1948.

Haddock. This species showed a continuance of the decline previously reported in the Dutch catches between 1947 and 1948. There was, however, a recovery in the smallest market category towards the end of 1949.

Whiting. Trawled samples in the course of the French investigations in the autumn of 1949 were found to be smaller in the eastern Channel than in the North Sea. In the former area and in the latter area at Little Fisher Bank and Old Devil Hole they were thought to be mainly one and a half years old; in the "Silver Pit" the average age appears to have been two and a half years.

Plaice. An interesting change is revealed in the survival rate of the different year-groups of the English steam-trawler fishery. In 1947/1948 there was a high survival rate for the younger age-groups and a progressively lower one for the older age-groups. No such condition has been seen in pre-war years examined, indeed for one of them—1937/1938 and since the war for 1949/1948, the reverse has been the case. Among other explanations of this anomaly the possibility of the cold winter of 1946-47 causing a selective mortality on the older fish, may not be excluded.

The density of the plaice stock as revealed by the English and Dutch trawl and Danish seine fisheries, was less in 1949 than in 1948.

The main constituents of the fishery remain the III, IV, and V groups which replaced the older age-groups VI, VII and VIII in 1947. Danish results suggest that small plaice were relatively more abundant in the summer on the nursery grounds off Horns Reef and Terschelling.

Sole. Dutch and English investigations show that the fishery for soles improved sharply towards the end of 1949 and it seems clear that the recovery may be attributed to the advent of a very strong recruit group composed of fish of the 1947 year-class. The English figures suggest that the recruits entered the fishery from nursery grounds off the coast of Holland, Germany and southern Denmark, moving rapidly westwards.

Sprat. The assistance of echo-sounding apparatus in locating and identifying different species of fish has resulted in an explanation of the whereabouts of the winter shoals of this species which had failed to appear in substantial numbers during the seasons 1948-49 and 1949-50 off the S.E. coast of England. In an echo-survey of the Thames estuary and the Southern Bight, two English research ships found that echo-traces of sprat shoals appeared mainly in the eastern part of the Southern Bight and that they were virtually absent from their usual English grounds. Heavy concentrations were also indicated S.E. of Margate and off the Galloper, which were unknown to English fishermen but of which at least one could have been exploited.

Black Sea-Bream. A preliminary observation on trawl-caught individuals of this species made by M. DESBROSSES in October off Cap d'Antifer, revealed a sample of two and a half-year old fish with a modal length of 20 cms and which were considered from their scale readings to have grown 9 cms in their first year, 6.5 cms in the second and 5-6 cms in the third.

R. S. WIMPENNY.

ENVIRONMENT.

Hydrography.

Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Anomalies from these Means in 1948.

(From the Danish Meteorological Institute, Nautical Dept.).

Month:	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX
Salinity at Surface.												
Mean	32.4	32.4	32.9	32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6
1948	0.0	0.1	0.3	0.8	1.6	1.6	0.9	1.3	0.9	—	0.9	0.0
Salinity at Bottom.												
Mean	32.6	32.7	33.0	33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.7	32.8
1948	0.2	0.2	0.8	1.1	1.5	1.6	0.9	1.5	1.0	—	0.9	0.2
Temperature at Surface.												
Mean	12.2	8.5	5.4	3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0
1948	0.3	0.7	1.8	1.8	2.1	0.7	0.7	—0.1	—0.5	—	—0.7	1.9
Temperature at Bottom.												
Mean	12.7	9.0	6.2	3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.2
1948	0.4	0.9	1.9	1.7	2.1	0.9	0.9	0.6	0.4	—	—0.6	1.6

HELGE THOMSEN.

Mean Monthly Data of Surface Salinities and Temperatures from the Hull—Hanstholm Route for 1947, 1948 and 1949, and at Smith's Knoll, Galloper and Varne Lightvessels 1946—49.

Hull-Hanstholm 1947 Salinity										Hull-Hanstholm 1948 Salinity									
Stations	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
1) Lat. N.:	08° 08'	01° 21'	01° 30'	02° 00'	05° 05'	03° 00'	05° 34'	04° 00'	06° 00'	53° 56'	01° 00'	54° 09'	01° 30'	54° 22'	02° 00'	54° 50'	03° 00'	55° 17'	04° 00'
Long E:	54° 01'	54° 01'	54° 39'	55° 05'	55° 03'	56° 00'	56° 22'	56° 45'	57° 06'	53° 56'	54° 09'	54° 22'	54° 50'	55° 17'	55° 45'	56° 12'	56° 36'	57° 00'	57° 02'
April.....	—	—	—	—	—	—	—	—	—	34.56	34.56	34.60	34.56	34.58	34.58	34.56	34.38	33.95	
May.....	34.57	34.70	34.73	34.62	34.56	34.62	34.40	34.30	34.53	34.59	34.57	34.60	34.67	34.63	34.68	34.36	34.38	34.28	
June.....	34.68	34.72	34.74	35.16	43.61	34.64	34.32	34.31	31.79	34.32	34.44	34.49	34.58	34.65	34.62	34.46	33.79	33.64	
July.....	34.48	34.56	34.70	34.64	34.64	34.57	34.42	34.33	33.77	34.28	34.49	34.65	34.77	34.78	34.54	34.12	33.95	33.22	
August...	34.60	34.62	34.66	34.66	34.70	34.55	33.68	33.48	32.36	34.33	34.49	33.89	34.64	34.74	34.67	34.48	34.46	34.13	
September	34.40	34.44	34.40	34.48	34.54	34.69	34.14	33.28	33.48	34.46	34.46	34.46	34.51	34.74	34.88	34.60	34.59	34.31	
October...	34.52	—	—	34.55	34.57	34.64	34.47	34.48	34.33	34.42	34.54	34.46	34.60	34.72	34.84	34.60	34.67	34.37	
November	34.47	34.54	34.54	34.63	34.71	34.70	34.58	34.56	34.52	34.32	34.50	34.60	34.82	34.71	34.70	34.57	34.59	34.55	
December	34.59	34.66	34.70	34.76	34.76	34.74	34.60	34.68	34.24	34.54	34.57	34.57	34.76	34.80	34.79	34.62	34.60	34.68	
Temperature										Temperature									
April.....	—	—	—	—	—	—	—	—	—	7.1	7.0	7.6	7.2	7.4	7.0	6.8	8.6		
May.....	10.4	10.0	10.4	11.4	9.8	8.3	8.3	8.7	9.2	9.0	9.1	9.9	10.0	10.1	9.9	9.5	9.5	8.6	
June.....	10.7	11.8	12.5	13.4	12.8	12.7	12.0	12.0	14.3	11.3	11.5	12.0	13.4	12.9	12.0	11.7	12.8	12.1	
July.....	13.2	14.5	16.2	15.8	16.2	16.5	16.8	16.3	14.4	12.6	13.0	14.2	14.7	14.6	14.6	15.5	15.4	15.8	
August...	15.8	18.2	18.2	18.6	19.2	19.4	19.4	19.0	19.0	13.3	14.0	15.1	15.7	15.5	15.6	16.0	16.1	16.3	
September	17.7	17.6	18.2	17.7	19.0	19.9	21.5	20.2	19.8	14.6	14.4	14.2	14.4	14.3	14.1	15.1	14.7	14.5	
October...	13.5	—	—	15.3	14.9	15.5	15.0	14.5	11.7	13.4	13.6	13.3	13.1	12.8	12.4	13.2	12.7	11.7	
November	13.4	14.3	12.2	12.1	11.9	11.9	12.6	11.8	11.7	11.7	12.0	10.6	10.3	10.2	10.2	11.1	11.0	10.5	
December.	9.2	9.4	9.2	8.5	9.6	9.1	10.2	9.6	8.4	10.0	10.4	9.7	9.0	9.2	9.1	9.7	9.6	9.4	

Hull-Hanstholm 1949
Salinity

Stations	1	2	3	4	5	6	7	8	9
¹⁾ Lat. N.:	53° 53' 01° 00'	54° 08' 01° 30'	54° 21' 02° 00'	54° 44' 03° 00'	55° 14' 04° 00'	55° 41' 05° 00'	56° 12' 06° 00'	56° 35' 07° 00'	57° 02' 08° 00'
Long. E.:	53° 53'	54° 08'	54° 21'	54° 44'	55° 14'	55° 41'	56° 12'	56° 35'	57° 02'
January ..	34.65	34.70	34.66	34.61	34.70	34.75	34.60	34.55	34.65
February ..	—	—	—	—	—	—	—	—	—
March.....	34.66	34.76	34.90	34.98	34.92	34.90	34.67	34.77	34.76
April.....	34.70	34.78	34.96	34.99	34.92	34.83	34.66	34.68	34.69
May.....	34.73	34.81	34.93	34.97	34.93	34.84	34.63	34.54	34.57
June.....	34.68	34.68	34.99	35.15	35.01	34.93	33.98	33.18	32.36
July.....	34.63	34.86	35.00	35.00	34.96	34.63	32.85	31.84	31.06
August....	34.68	34.75	34.88	34.93	34.70	34.12	34.48	34.18	33.44
September	34.74	34.80	34.86	34.91	34.76	34.35	34.31	34.16	34.14
October....	34.52	34.66	34.68	34.76	34.72	34.69	34.71	34.17	33.58
November	34.46	34.53	34.58	34.64	34.69	34.71	34.60	34.55	34.44
December.	34.55	34.58	34.64	34.75	34.78	34.76	34.74	34.71	34.62

Temperature

January ..	8.1	8.0	7.0	7.0	7.2	7.2	7.5	7.5	7.4
February ..	—	—	—	—	—	—	—	—	—
March.....	5.7	6.0	5.8	5.5	5.7	5.4	5.3	5.1	5.0
April.....	6.9	6.9	7.4	7.1	6.9	6.5	6.2	6.2	6.0
May.....	8.5	8.5	9.1	9.4	9.1	8.6	8.5	8.4	8.6
June.....	11.8	11.8	13.2	12.6	12.1	11.8	11.9	12.4	14.0
July.....	12.7	14.0	15.4	14.9	13.9	14.7	15.2	15.7	16.0
August....	14.5	15.4	16.0	15.6	15.6	15.7	15.4	15.0	14.8
September	15.6	16.6	17.4	17.1	16.8	16.4	16.6	16.3	16.0
October....	14.3	14.4	15.1	15.2	15.2	15.2	14.8	15.1	14.9
November	10.5	10.7	11.3	11.4	12.1	12.2	12.5	12.9	12.6
December.	8.7	8.6	8.2	8.6	8.7	8.6	9.7	9.6	9.6

¹⁾ Latitude is the yearly mean for each station.Smith's Knoll, Galloper and Varne Lighthvessels
1946—49
Salinity

Smith's Knoll 52° 43' N., 02° 18' E.				Galloper 51° 44' N. 01° 57' E	Varne 50° 56' N. 01° 17' E.
1946	1947	1948	1949	1949	1949
—	—	—	34.50	35.38	—
—	—	—	34.40	35.24	—
—	34.01	—	34.25	34.98	—
—	33.77	34.13	34.32	34.71	—
—	33.36	34.06	34.44	34.71	—
—	33.29	34.12	34.25	35.12	—
—	33.52	34.09	34.45	34.95	—
—	33.68	34.13	34.35	35.03	35.14
—	—	34.22	34.44	35.05	35.92
—	—	34.24	34.44	35.13	35.06
34.48	34.42	34.38	34.65	35.24	35.24
34.36	34.53	34.74	34.51	35.23	35.31

Temperature

—	—	—	7.1	8.2	—
—	—	—	5.9	7.2	—
—	2.3	—	5.3	5.9	—
—	3.8	7.0	7.3	8.0	—
—	7.8	9.6	9.4	9.8	—
—	11.6	12.5	12.0	12.0	—
—	15.4	13.9	15.0	15.1	—
—	17.0	15.9	16.8	16.8	17.8
—	—	16.1	17.4	18.0	18.2
—	—	14.5	16.4	16.3	17.6
11.6	11.9	11.9	12.1	11.6	14.2
—	8.3	9.9	8.7	9.0	11.5

J. R. LUMBY.

Studies of Water Movements and Winds at
Various Lighthvessels in 1938, 39 and 40.

The Varne Lightship and her Successors.

Introduction.

There is no need in any publication of the International Council to argue a case for the value of continuous observations on water movements in the sea. All workers in the field of Marine Biology at large, and in that of Fisheries Research in particular, will be familiar with a very substantial number of papers which have done so.

We may recall that particular interest has long attached to such observations in Dover Straits, the issuing flow of water through which into the North Sea is deemed to be well worthy of persistent study for reasons which have often enough been set out in detail.

Very shortly after the end of World War II, the desirability of relating water movements to the dispersal of plankton, of floating fish

eggs, and to other happenings in the sea of concern to the fisheries researcher, was ventilated anew in deliberations sponsored by the Council. At that time a paper was published which, it is thought, set out a useful scheme of work (1). Since then, sight has not been lost of the desirability of re-starting the observations which had, before the War, produced unbroken data on the flow of water through Dover Straits in so far as that could be judged from measurements made at the strategically-placed Varne Lightvessel. Plans are afoot to resume that work.

Clearly, it would be well first to fill in the gap between what has gone before and what may come later, by putting on record whatever unpublished data are presently available.

There is a body of such for a number of lightships, and it is hoped to achieve *extenso* publication by the Admiralty of the relating records in due course. In advance of that, it has been thought good to publish a series of

review papers of which this present one is number four.¹⁾

In what follows, only minor citations will be made from the results of work done before the installation of the Vertical Log current-meter aboard the Varne (in the Spring of 1938), very substantial in amount though that work was. The observations made by means of the Vertical Log are held to be more acceptable than those obtained by other means. The rather humdrum instrument in question has been very fully described in a number of papers—some published by the Council—and an illustration of it is readily available (2).

This last-cited paper contains all the Vertical Log data from the Varne so far published; they consist of monthly averages from March 1938 to March 1939. These data are made use of in what follows, but to them are added the data which had not previously been published.

Owing to various circumstances brought about by wartime difficulties, some of the original daily records from the Varne have been lost, and we have only monthly summaries for part of the period during which the Vertical Log instrument was in continuous use there.

When the Varne lightship was withdrawn from her station, the instrument was removed and installed successively in three other light-vessels whose positions are given later. Regrettable though it was that the continuous work at the Varne position had to cease, it did mean that it became possible to transfer the observing to positions considerably shorewards.

One had often wished for the opportunity to learn how the water travelled overall at places between the Varne and England; there had not, however, been an earlier opportunity of doing so, because no permanent observing positions had been available. It may well be that the opportunity (the presence of lightships) will not recur.

Earlier papers by the senior author have dealt with long series of observations made at

the Varne with his Drift Indicator (reports published by the Ministry of Agriculture and Fisheries), and, in a short paper published by the International Council in 1930 (3) based upon some 1,170 days of observing with it, attention was paid to what had been, up to that time, the two most pronounced extremes of experience.

The most usual finding had been an overall water travel towards the North Sea; the "representative record" (whole-time vector resultant) had attested a NE.-going residual current of 2.7 miles a day. As to the extremes referred to, these had been an overall flow of about 21 miles a day towards the North Sea, and a NE. wind-caused reversal amounting to a daily SW.-going travel of about 13 miles.

In a much more recent paper (4), the comparable extremes as observed by the Vertical Log current-meter were made known. Admittedly, the observations spanned a much shorter period of time, and the pair of records concerned may not always remain the outstanding opposites in consequence; they are, however, more reliable than the earlier-cited pair of extreme records obtained with the Drift Indicator.

The later extremes observed with the Vertical Log were, an overall water travel of 18.6 miles a day towards the North Sea at a time when strong SW.'ly winds held sway, and a reversal (a Channel-wards flow) amounting to 14.7 miles a day at a time when strong winds from the NE. quadrant ruled the situation.

In what follows, one of us gives something of the results obtained by studying the association of wind and overall water travel, but much more may be got from the available data than can be included in a paper of the present size.

Althoughs no observations are being made with the Vertical Log at the present time under British sponsorship, the instrument is in continuous use from a number of Netherland's lightvessels, and graphical presentations of the results procured are kindly passed to the authors by Dr. J. VAN VEEN.

It is expected that, before long, a programme of continuous observations on the water movements past the West Hinder lightvessel will be instituted by the Belgian Hydrographer. It is proposed to install a Vertical Log there; if this comes to pass, one may look for information of very great interest indeed in connec-

¹⁾ Earlier papers in the series, and the publications in which they have appeared, or are due to appear deal with water movements and winds at:—

1. Mouse Light Vessel, in the Thames Estuary ("Weather").
 2. Seven Stones Light Vessel, near the Scilly Isles, (Journal of the Marine Biological Association).
 3. North Goodwin Light Vessel ("Marine Observer").
- Papers are also due to be prepared for the Cromer Knoll and Royal Sovereign Light Vessels.

tion with plaice egg distributions and the drift of plaice larvae.

Space does not serve to develop ideas on the usefulness of the type of observing here under report to other than marine biologists.

Results.

The positions (see Figure 1) and other details concerning the four lightvessels to which this review refers are tabulated on page 120. The recorded observations are plotted in Figure 2.

Water movements occurred towards the NE. and SW. octants only, the overall or residual movement being predominantly north-easterly.

As a first step in the investigation of the association between residual water movement (overall flow) and wind, the monthly averages, illustrated in Figure 3, were considered. This figure includes such vertical log data from the Varne as have already been published (2).

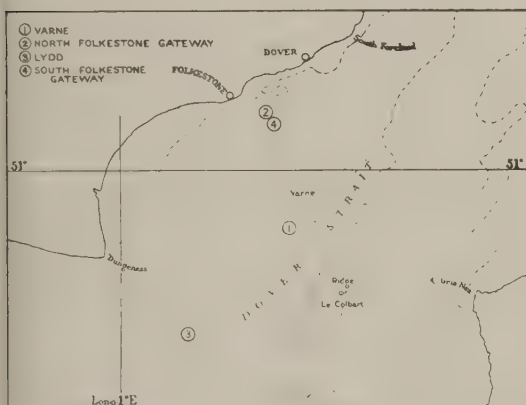


FIGURE 1—POSITIONS OF VARNE LIGHT VESSEL AND ITS SUCCESSORS

Considering months of north-easterly residual water movements, it now appears that in general the magnitude of the latter varied with the strength of the SW. wind. Furthermore, weak or average residuals were associated with winds outside the NE. and SW. quadrants. Below-average residuals occurred when winds were opposing.

Monthly south-westerly residual water movements were evident in the following months:—1938—April, 1939—May, September, (part) December, 1940—May, (part) June.

In considering whether this reversal of the residual movements might be periodic, too much weight, it is felt, should not be attached

to those months for which data are available for only a part. Also, in September, 1939, a very strong NE. wind was associated with a fractional SW. residual, whereas in April, 1938 the same wind was associated with a SW. residual 30 times as great. This gives some support to past findings that reversals of the flow might be particularly characteristic of the spring months.

To bring out more clearly the association between NE. and SW. water and wind movements, a modified wind plot was superimposed upon the residual water movement plot (Figure 2). This was effected by calculating the resultants of the N/S and E/S wind components and plotting these, with their directions reversed, about the average wind for the whole period during which observations were taken from each particular lightvessel. This average was made congruent with the appropriate average residual water movement. In only about 10% of the observations thus analysed was the residual water movement in opposition to the residual wind; it may well be that in these cases the intrinsic water movement was sufficiently large to overcome any wind effect.

In regions where the two plots were particularly homothetic it was assumed that the water travel was produced by the wind alone. Accordingly graphs of residual water movement/wind travel were plotted for each of the four lightvessels; the one for the Varne has been reproduced in Figure 4. In this there are two graphs, one for NE. wind/SW. water movement and the other for SW. wind/NE. water movement. In accordance with the findings of THORADE (5), optimum parabolas were drawn through points where the winds were of strength 3 (Beaufort scale) or less, and optimum straight lines for winds of greater strength.

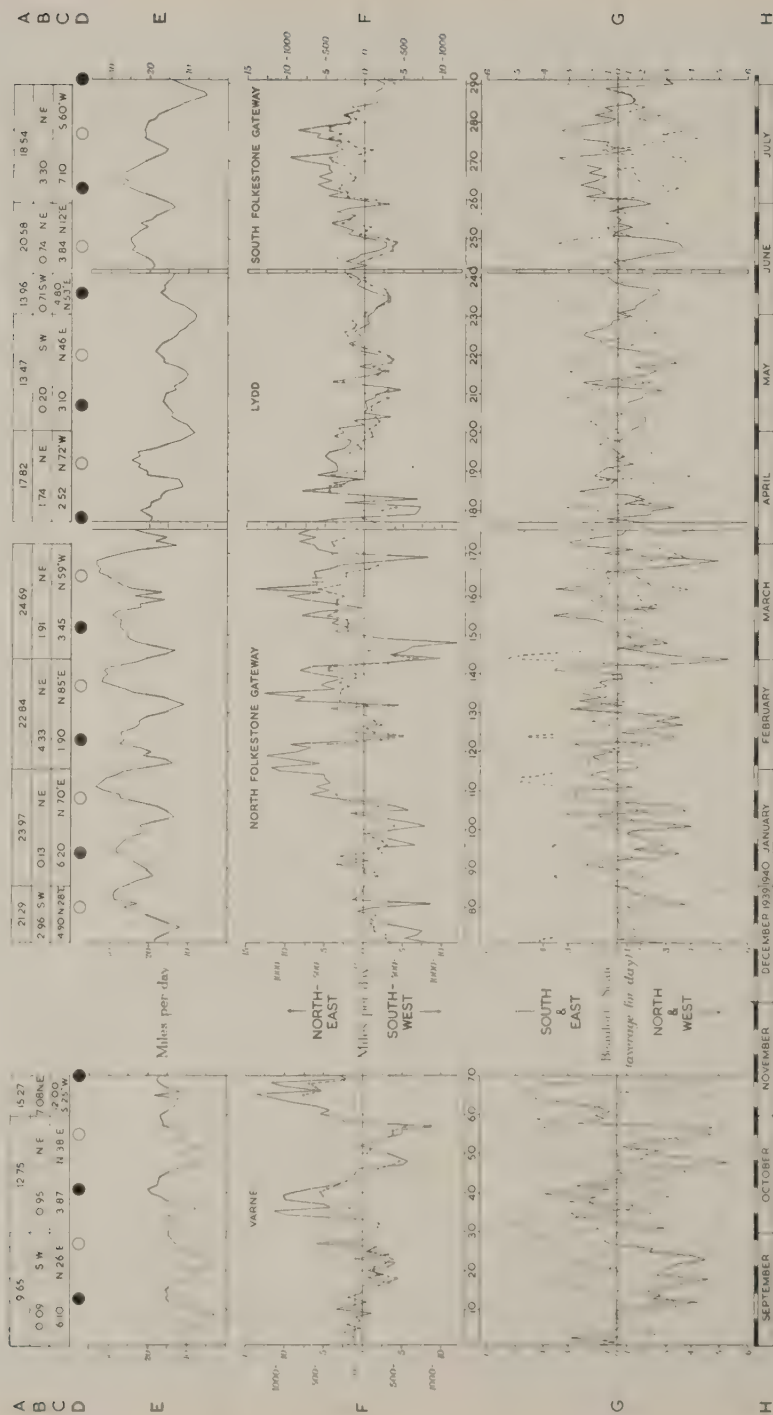
THORADE's two equations relating wind velocity to water velocity are:—

$$V_w = \frac{2.59 \sqrt{V}}{\sqrt{\sin \lambda}} \quad (V \leq 240 \text{ m.p.d.}) \quad \dots\dots (A)$$

$$V_w = \frac{1.26 V}{\sqrt{\sin \lambda}} \quad (V > 240 \text{ m.p.d.}) \quad \dots\dots\dots (B)$$

where V_w = velocity of water movement
 V = velocity of wind travel
 λ = latitude

FIGURE 2—WATER MOVEMENT AND WIND IN THE STRAITS OF DOVER — SEPTEMBER 1939 — AUGUST 1940



Key

- A Average monthly total water movement (the summed daily mileage, irrespective of direction) in miles per day.
- B Average monthly residual water movement (the net travel or "overall make" of the water) in miles per day and the octant in which it lay.
- C Average monthly residual wind strength, in miles per hour, and direction.
- D Full and new moon.
- E Daily total water movement, in miles per day.
- F Continuous line — Daily residual water movement, in miles per day. Pecked line — Mean daily SW. and NE. wind travel, in miles per day.
- G Mean daily residual wind, in Beaufort scale. North and South components are drawn in full line, East and West components in pecked line.
- H Calendar; black and white bars represent weeks of seven solar days.

Notes. (i) All days are lunar days of 24 hrs. 50 min., unless otherwise stated.

(ii) All miles are sea miles of 6080 feet.

(iii) All directions are magnetic. (Variation = 10° W.)

Considering equation (B), which represents the straight portions of the optimum curves, V_w is in cm./sec. and V in m./sec. Converting to other units, and putting $\lambda = 51^\circ$ —

$$V_w \text{ (m.p.d.)} = 0.35 V \text{ (m.p.h.)}$$

or, Water Movement = $1\frac{1}{2}\%$ of Wind Travel.

Taking the slopes of the optimum lines, the values obtained are shown in the following table.

Lightvessel	NE. Wind/SW. Water Movement	SW. Wind/NE. Water Movement
Varne.....	1.50 %	1.75 %
North Folkestone Gateway	1.35 %	1.40 %
South Folkestone Gateway	0.75 % ¹⁾	1.67 %

¹⁾ This result is unreliable due to lack of points.

No optimum curves were drawn for the Lydd lightvessel, because it was thought that water movements other than those due to wind were exerting considerable influence and that the plots were not sufficiently homothetic.

The fact that NE. winds are associated with SW. water movements of lesser magnitude at the two Folkestone Gateway lightvessels than at the Varne is probably attributable to coastal shielding.

Acknowledgement.

The authors desire to express their thanks to Lieutenant Commander J. F. GRUNING, D.S.C., R.N., for basic computational work; to the crews of the lightvessels concerned; and to the English Fisheries Department, for allowing the instruments used to remain available after the outbreak of war.

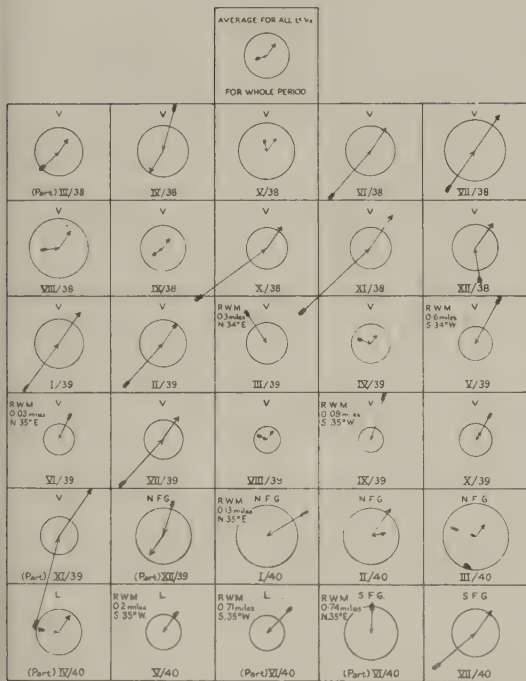


Figure 3. Monthly Average Total and Residual Water Movement and Residual Wind at Varne Light Vessel (and successors).

Circumference of Circle = Total Water Movement (M.P.D.)
Plain Arrow = Residual Water Movement (M.P.D.)
Feathered Arrow = Residual Wind (M.P.H.)

All Directions are True. Letters at Tops of Squares indicate particular Light Vessel.

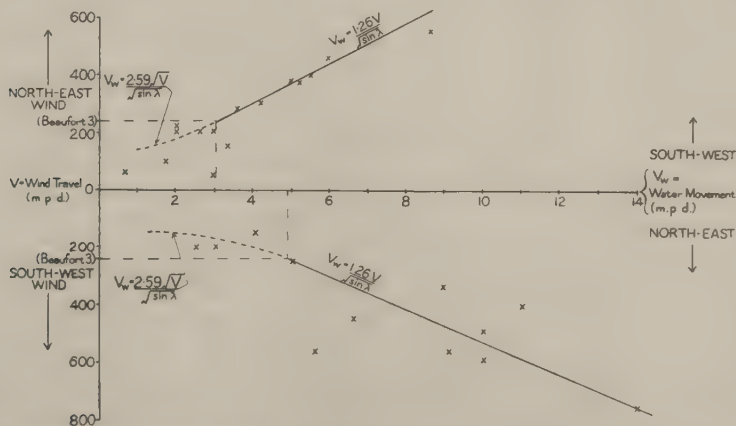


Figure 4. Residual Water Movement/Residual Wind Travel at Varne Light Vessel.

Summary.

Lightvessel	Varne	North Folkestone Gateway	Lydd	South Folkestone Gateway
Position . . .	50° 56.2' N. 1° 16.6' E.	51° 04.4' N. 1° 14.6' E.	50° 49.8' N. 1° 0.63' E.	51° 03.6' N. 1° 15.5' E.
Mean Depth (fms.) . . .	26 (5. 3.38)	22	30	21
Period. . . .	1. 9.39 to 11.11.39	16.12.39 to 4. 4.40	6.4.40 to 12.6.40	13.6.40 to 3.8.40
No. of Observations	70 (591)	105	65	50
Water Layer covered by Observations	One to two fathoms below surface			

Total Water Movement (miles per day)

Maximum	20.0	33.5	24.5	27.6
Average .	11.9 (16.6)	23.3	15.2	19.1
Minimum	3.4	10.9	8.0	5.3

Daily Water Movement (miles per day)

SW. (mag.) NE. (mag.)	Maximum	16.2	19.9	14.4	16.8
	Average	6.7 (9.4)	12.5	7.8	10.6
	Minimum	0.0	3.1	3.8	1.9
	Maximum	12.5	19.4	14.7	13.7
	Average	5.2 (7.2)	10.9	7.4	8.5
	Minimum	0.4	3.2	2.9	3.4

Average Residual Water Movement

(miles per day)	1.5 NE. (2.1 NE.)	1.6 NE.	0.4 NE.	2.2 NE.
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Residual Water Movement on Octants (miles per day)

NE. (mag.)	Maximum	13.8	14.0	8.1	9.7
	Average	4.5	5.5	2.6	3.6
	Minimum	0.1	0.0	Nil	0.4
	Frequency %	58.6	58.5	55.4	74.0

SW. (mag.)	Maximum	8.9	12.2	7.3	3.3
	Average	2.6	3.8	2.3	1.8
	Minimum	0.1	0.1	Nil	0.4
	Frequency %	41.4	41.5	43.1	26.0

Mean Residual Wind

Speed (m.p.h.)	2.3 (2.4)	2.1	1.9	2.9
from (magnetic)	N.36° E. (S.73° W.)	N.40° E.	N.24° E.	S.83° W.

Note:— Figures in brackets include observations already published in Ref. 2, and unpublished observations relating to the period April, 1939—August, 1939. Daily records not being available, the bracketed averages have been calculated from monthly summaries.

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- (4) J. N. CARRUTHERS. "Realism on Current-Measuring in the Upper Layers of the Sea". *Int. Hydr. Rev.*, Vol. XXIV, Monaco, 1947.
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J. N. CARRUTHERS, A. L. LAWFORD
and V. F. C. VELEY.

Some Unpublished Records of Overall Water- Flow past various Lightvessels off the Netherlands Coast from 1939 and 1940.

As will be well-enough known, there was in operation before World War II an extensive programme of continuous current-measuring from various lightvessels. These were of English, French, Netherlands and, for a few months, Danish nationality. It was the practice to publish a yearly review of the results in the *Rapp. et Proc.-Verb.* of the International Council. These annual reviews were written by the present writer (despite the "nationality" of the data) in his capacity of Recorder on Currents.

An attempt is being made to get the work re-started; in fact the observations are already in progress again without intermission from the two Netherlands lightvessels, 'Texel' and 'Goeree'. Graphical presentations of the results which have accrued since April and January 1947 respectively from those two positions, are held by the writer, thanks to Dr. J. VAN VEEN of the Rijkswaterstaat.

Before any full-scale international resumption of the work gets under-way, it is desirable that all records relating to the past should be published, and for permission to publish what follows, thanks are again expressed to Dr. J. VAN VEEN.

For various reasons which hardly need stating, long-term data on the overall water-flow off the Netherlands coast, have a rather special interest for the fisheries researcher.

Year 1939	March		April		May		June		July		August	
Month												
Lightvessel	Miles/Day Residual	Direction N.	Miles/Day Residual	Direction N.	Miles/Day Residual	Direction N.	Miles/Day Residual	Direction N.	Miles/Day Residual	Direction N.	Miles/Day Residual	Direction N.
Maas.....	1.5	5°W.	2.7	8°W.	1.9	15°W.	1.5	5°W.	1.4	18°W.	2.7	1°E.
Terschelling Bank.....	2.5	28°E.	4.3	37°E.	0.5	9°W.	3.0	17°E.	9.0	36°E.	7.3	34°E.
North Hinder.....	1.8	S. 84°E.	2.4	78°E.	2.3	84°E.	—	—	—	—	3.7	45°E.
Haaks.....	1.0	59°W.	3.0	22°W.	2.3	54°W.	1.2	8°E.	5.4	24°E.	2.7	8°E.
Year 1940	12/1—31/1		February		March							
Terschelling Bank Lightvessel,	3.9	42°W.	3.5	14°W.	2.6	75°E.	—	—	—	—	—	—
(New Position)												

Before the appearance of this present note, such data as had accrued from observations made at the Maas (52° 01'N., 03° 54'E.), Terschelling Bank (53° 27'N., 04° 47'E.), North Hinder (51° 38'N., 02° 34'E.), and Haaks (52° 58'N., 04° 19'E.) lightvessels had been set out in the July 1939 issue of the Council's Rapp. et Proc.-Verb. (Vol. CIX, III, 5). In that article, the present writer also figured the instrument with which the observations had been made.

It is to be recalled that the whole-month residual current averages there published, were expressed, not in miles per day, but in kilometres per tide; to be brought to the customary former unit they need raising by 8 per cent.

The following additional month-average data are now made available, and this time they are expressed in miles per day towards true directions.

An additional small amount of information was also received from Dr. VAN VEEN in May 1940, relating to observations at a new position of the Terschelling Bank Lightvessel (some 30 miles due west of its former position).

It is expected that month-average data comparable to those presented above, but relating to the post-war observations now in train at the 'Texel' and 'Goeree' lightships, will shortly be made available by Dr. VAN VEEN.

These would be computed from the half-year-long graphs customarily prepared in the Rijkswaterstaat; a specimen of one of these extremely useful compilations can be seen in the present author's paper: "Realism in Current-Measuring in the Upper Layers of the Sea" which appeared in the Monaco *Hydrographic Review* in 1947 (Volume 24).

There is good cause to welcome the intention of the Belgian Hydrographer in the line of such work as that here under report; he contemplates installing a Vertical Log on board the West Hinder lightvessel. This should promise information from a position at which it had long been hoped to work—from a place having special significance in respect of plaice larvae drift to mention but one thing.

J. N. CARRUTHERS.

Plankton.

Zoo- and Phytoplankton of the Flamborough Line, 1946—49.

The Hensen net results are dealt with here from the Flamborough Line between July 1946 and December 1949. It should be pointed out, however, that sampling in the latter part of 1949 was complete only in July, September and November. The results refer only to the total numbers of the phytoplankton and of the zooplankton, while the dry weight and fat content of duplicate hauls are dealt with by Mr. WIMPENNY separately. The position of the

stations, the Hensen net used and the method of its operation has been described fully by WIMPENNY (1944). The six stations of the Flamborough line have been considered together and the average catches per cubic metre are plotted in Figure 5 at their monthly intervals.

The Zooplankton show comparable values to those found by WIMPENNY (1944) between 1933 and 1939. 1946 is, however, a difficult year to interpret from the six months available. There is a peak in September and if this is of

a secondary order the main maximum would have occurred earlier in the year. As, however, July's figures are of a low order the maximum if it existed would have had to be extremely early, in June. The September peak is too late for it to represent a typical main maximum as does the August one of 1948. Whatever are the true facts, the data suggest that 1946 was a poor year for zooplankton production. Production increased to 1947 and thereafter decreased to 1949. No collection was made in August 1949 so that it is impossible to say whether the main maximum occurred in this month. June, however, showed a small peak so that it is improbable that the August figures would have been of any great magnitude. 1947 showed an unusual curve in being more reminiscent of that usual for phytoplankton with a main maximum in July and a secondary peak in September, while 1948 showed a typical curve for the North Sea with a small early peak in May and the main maximum in August.

The graph of the zooplankton has been split as in former years into upper and lower halves, the former showing the proportion of eggs and juvenile stages. It should be noted in relation to this that the practice has been continued of including the copepodid stages of the copepods with their adults. The representation shows reproduction to have been vigorous throughout the period, but that there are no special upward or downward trends. In 1947 and 1948, however, reproduction was much more pronounced from August onwards and this is possibly true for 1946.

As in previous years the peridinians have been included in the phytoplankton but in no case have their numbers affected the graph. Only in August 1948 and July 1949 did their number in fact exceed 1,000 per cubic metre. At the former date there were 1,011 per cubic metre when the diatom figure was 112,551 and at the latter 1,789 against 3,268. In this last case, however, although the peridinians (almost exclusively *C. macroceros*) represented over half the total phytoplankton, this latter was so small as to be insignificant. The graph represents, therefore, virtually only the diatoms.

In contrast to the zooplankton, the phytoplankton shows striking differences from that of pre-war years. The standing crop in any year will depend upon a number of factors, but if the physical conditions allow of an early flowering this will take place at a time

when the zooplankton is relatively low in numbers and will reach, therefore, far larger proportions than when the flowering takes place later. WIMPENNY found it necessary to use two scales for the phytoplankton in plotting the years 1933 to 1939, the change-over taking place at the 40,000 per cubic metre level. Omitting 1946, this same level has been reached only three times, once in each of the years 1947 to 1949 and exceeded only in the last two years. The peaks have increased from 1947 to 1949 in which latter year even it stood at only 129,914 per cubic metre. In 1935 the figure reached 1,223,146 per cubic metre, and throughout the years 1933 to 1939 the 40,000 per cubic metre level was reached or exceeded at least thirteen times. Whereas the main peak for 1948 coincides with the zooplankton maximum in August and that of 1949 in May is not far in advance of the June zooplankton maximum, the peak in 1947 occurred in April when the zooplankton was at a very low level. Moreover, this peak is the

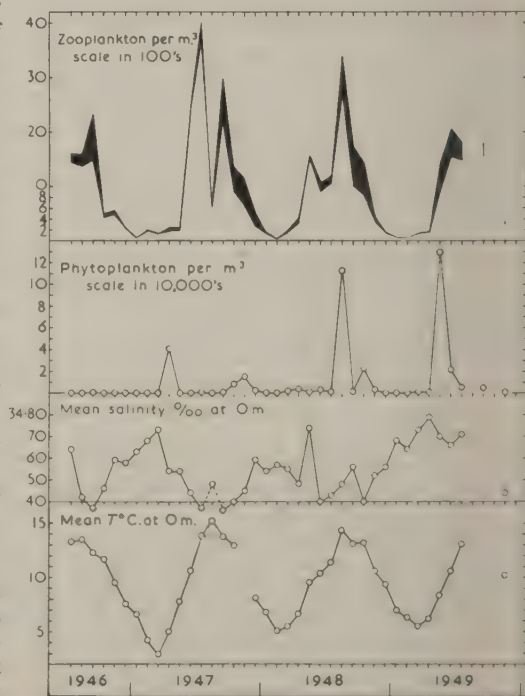


Figure 5. Mean monthly Values at six Stations between Flamborough Head and the Dogger Bank for Zooplankton, Phytoplankton, Salinity and Temperature.

smallest of those already referred to and only just reached 40,000 per m³. Apart from a small secondary peak in November 1947 and another in October 1948 the remaining part of the curve is remarkable in that it is almost impossible to represent it under the scale used. One can conclude, therefore, from the above that the standing crop of phytoplankton was at a far lower level in 1947 than in pre-war years, but that from then onwards it has been recovering.

It is useful in connection with the phytoplankton to consider the mean temperature of the surface water in April, for if this is relatively high and other physical or chemical factors are not adverse, this will favour an early outburst of the spring diatoms. The values for the years under consideration are tabulated below:—

April mean T°C. at 0 m. Flamborough Line.

1933	1934	1935	1936	1937	1938	1939	1947	1948	1949
7.09	7.09	<6.92	6.69	6.10	7.01	6.91	5.06	6.71	6.2

It will be seen at once that the April post-war temperatures were in all cases below those of the previous years except in 1937 and 1936 (the latter is only slightly below that of 1948), and that that of 1947 was by far the lowest recorded throughout the period under consideration. The small peak of phytoplankton production in April 1947 was associated in fact with a temperature as low as 5.06°C.

Finally, it should be emphasized that large quantitative values of total phytoplankton or total zooplankton are not associated necessarily with large percentage weights of fat, and that totals of particular species especially in the phytoplankton are far more important. WIMPENNY for example, records (p. 125) for 1948 an extremely large value for the percentage fat in May when the quantitative value of total zooplankton was not very great and that for total phytoplankton was extremely low. Examination of the detailed plankton sheets reveals that the fat was derived most probably from the relatively large numbers of *Coscinodiscus concinnus*, a big diatom, which made up the total plankton in this month.

The line of six stations is situated in a area in which it is apparent that the currents are extremely complex. Some idea of the conditions may be gathered from LUMBY and

CARRUTHERS (1928). As far as the peaks of salinity are concerned nothing can be said except that these occurred in March (1947), May (1948) and April (1949). Considering the salinities for the whole period shown in Figure 5 it is evident that the trend has been from one of low values, upwards progressively to 1949. The most striking characteristic is, however, the amplitude of variation throughout each year. This is far greater than in pre-war years, the minimum falling below 34.40‰ in 1946 and 1947, while it fell to this figure in 1948. Observations are incomplete for the year 1949. The salinity never fell to this low value throughout the period 1933-39. The dotted line of the curve connecting the July and September 1947 observations with that of August is brought about by there being no surface salinity available at the Dogger Bank station in this last month. The salinity at 10 metres for this particular station has been used in computing the mean value.

The mean surface temperatures for the period are plotted in Figure 5. The April figures have been referred to above, but apart from this no further comment need be made except to point out the low minimum in February and high maximum in August 1947 corresponding to the extremely cold winter of 1946-47 and the following warm summer.

In conclusion it may be noted that the behaviour of the zooplankton in relation to salinity is the reverse of that of pre-war years so that it is improbable that salinity has any direct effect on the magnitude of its reproduction. The same cannot be said of the phytoplankton and the indications from 1947-49 are that, other factors being favourable, an upward trend will be helped by an increase in the salinity. The temperature round about April will be, however, of equal or even greater importance as far as the spring diatoms are concerned.

I. G. CATTLEY.

J. R. LUMBY and J. N. CARRUTHERS. An Experiment dealing with the Interpretation of Salinity Distribution Charts. Journ. du Cons., III, No. 2, p. 175, 1928.

R. S. WIMPENNY. Plankton Production between the Yorkshire Coast and the Dogger Bank, 1933-1939. Journ. Mar. Biol. Assoc. U. K., XXVI, pp. 1-6, 1944.

The Dry Weight and Fat Content of Plankton.

The collection of dried Hensen net samples in the Flamborough-Dogger area was continued in 1949 in the manner described in the first contribution to this series. The dry weights and percentage fat contents are in Figure 6.

The dry weights revealed maxima in May and October, at both of which months higher values were reached than in 1948. As sampling was not complete in 1949 and on that account it is not possible to make a full comparison with previous years, in the following tabulation I have supplemented a comparison of the weighted averages for the dry weights per m.³ for all stations available in the years 1947, 1948 and 1949 with a similar comparison for the months April—July inclusive and September, months in which data are available for all years.

	Whole year (mg. per m. ³)	April-July, September (mg. per m. ³)
1947	35	48
1948	33	42
1949	41	53

The relative picture for both comparisons is the same, the weight of the standing crop in 1949 was higher than in the two preceding years, 1947 in turn being above 1948.

The percentage fat content reached its maximum for the year in July when small copepods, *Evadne*, and some diatoms were responsible for values above 30%. There was a smaller maximum in April towards the Dog-

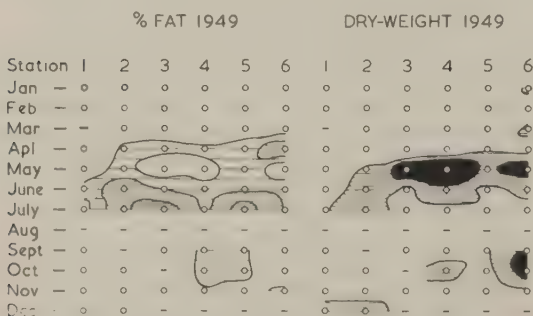


Figure 6. Percentage fat and dry weight for Hensen net hauls from six stations between Flamborough Head (Station 1) and the SW. Patch of the Dogger Bank (Station 6). The percentages of fat are contoured at 10 (wide-spaced lines), 20 (medium-spaced lines) and 30 (close-spaced lines) and the dry weights at 50 (close lines) and 100 mg. (black) per m.³ Observations were made at all stations indicated by a circle.

ger Bank side of the line, where the figure rose to 27.4 for samples of *Coscinodiscus concinnus*, a species which had put the fat percentage up to over 40 in May 1948.

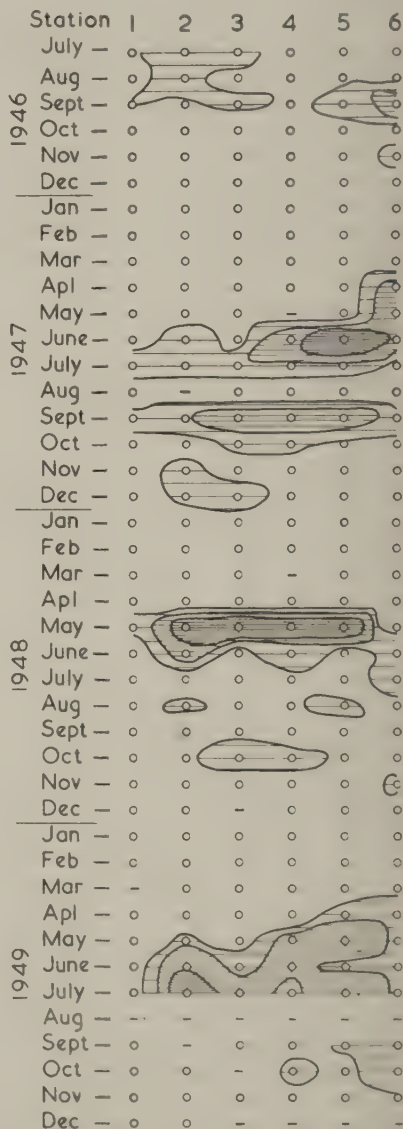


Figure 7. Milligrammes of fat per m.³ from Hensen net hauls at the Flamborough Line stations from July 1946 to December 1949. The contours are wide, medium and close-spaced lines for 5, 10, and 20 mg. respectively.

The amount of fat present in the samples can be expressed as mg. per m.³ in order to give similar comparisons to those already furnished for the dry weight.

It is seen that over this period and in this area the amount of fat in the standing crop of plankton is rather less than in 1948 but above 1947. The weight of fat per m.³ present at each of the Flamborough Line stations since July 1946 has been used to produce the contoured values shown in Figure 7. This shows clearly how the contours were more spread out over the summer months of 1949 than in 1948. It also brings out the single

	Whole year (mg. per m. ³)	April-July, September (mg. per m. ³)
1947	4.1	6.8
1948	5.1	7.8
1949	4.7	7.5

1947

1948

1949



Figure 8. Charts showing the distribution of the standing crop of dried Hensen net plankton per m.³ (above) and the weight per m.³ of fat in this plankton (below) for June 1947, 1948 and 1949. The dry weights are contoured at 50 (medium-spaced lines) and 100 (black) mg. per m.³. The fat weights are contoured at 10 (medium-spaced lines), 20 (close-spaced lines) and 30 (black) mg. per m.³.

maximum in May 1948 mainly attributable to the diatom *Coscinodiscus concinnus* and the two maxima of 1947, one in June and the other in September. The highest values appear to have shifted from the Dogger Bank side of the line in 1947 towards Flamborough Head in 1949.

Conditions off the NE. coast of England in June differ in some ways from those just shown for the Flamborough Line. The position in respect of dry weight in mg. per m.³ and fat in mg. per m.³ is shown for cruises covering this area in 1947, 1948, and 1949 in Figure 8. When the weighted averages are taken for the twelve stations north of the Flamborough Line the years compare in the following manner:—

	1947	1948	1949
Dry weight	55	46	44
Fat	18	12	9

There has thus been a successive decline both in dry weight and fat values since 1947. As the June cruises have been carried out partly for the purpose of finding out whether the plankton off the English NE. coast was related in any significant way to the herring fishery off North Shields, it is relevant to note that the herring landings at this port during the periods of the cruises fell away in the same direction as the fat values.

R. S. WIMPENNY.

THE FISH

The Dutch Fishery for Demersal Seafish in 1949.

Information about the Dutch North Sea fisheries continued to be collected in 1949.

Table 1 shows the total landings and their composition at IJmuiden. The total weight landed has decreased as compared with 1948. The landings of cod have remained nearly stable. The returns of haddock have decreased, notwithstanding a considerable increase in the landings of the smallest market categories. In the plaice all categories have decreased. The landings of soles have been doubled as compared with 1948. This is mainly caused by an important rise in the smaller categories, in the second half of the year.

The figures of den Helder (Table 5) give about the same picture. One of the factors influencing the figures of the total landings at IJmuiden will have been the change in the steam-trawler fleet. The decline in the density of the fish stock was the cause of many of the smaller steam trawlers having been laid up since January 1949. This resulted in a sharp decline in the total number of days absence of the steam-trawler fleet.

Table 2 shows the number of days absence, the quantity landed and the catch per day absence of the steam trawlers. The mean catch per days absence has declined as com-

pared with 1948. The extremely small numbers of days absence in late summer and autumn have been caused by the fact that most of the trawlers went fishing with the small-meshed trawl for herring and mackerel in these months.

These voyages have of course been omitted from our figures. The remaining numbers are too small to give figures as reliable as in previous years. Notwithstanding this a rise in the catch per days absence in the second half of 1949 is unmistakable (Figs. 9, B, and 10, B). This rise might show an improvement of the fish stock, but could also be a consequence of the bigger fishing capacity of the 1949 fleet as compared with previous years.

In order to find a correction for the differences in fishing capacity of the trawling fleet in the successive months since June 1945 we calculated a "fishing capacity factor" for each ship. The principle of our calculations was as following. One ship was taken as the standard one. The mean catch per day absence of the different trawlers was for each month expressed in percentages of the same figure of the standard ship. This has been done for the years 1948 and 1949. The mean of the percentages of each ship has been plotted against the indicated horse power of the ship in Figure 11. The points in this graph

Table 1. Quantities (in tons) of Demersal Fish landed in 1949 at the Port of IJmuiden.

Species	Market categories	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill		10.9	27.5	22.2	11.2	71.8
Cod	Large	560.2	466.4	247.7	144.2	1,418.5
	Medium	63.3	51.0	55.5	55.3	225.1
	Small	47.1	164.7	334.1	286.4	832.3
Total		670.6	682.1	637.3	485.9	2,475.9
Dab		745.0	516.0	196.6	226.4	1,684.0
Flounder		165.1	70.1	70.2	12.3	317.7
Gurnard and Latchet		134.4	242.8	79.4	109.2	565.8
Haddock	Large	66.8	105.2	101.6	66.2	339.8
	Medium	266.4	247.7	244.9	262.7	1,021.7
	Small I	102.3	130.6	177.9	396.5	807.3
	Small II	5.0	196.2	686.2	398.7	1,286.1
Total		440.5	679.7	1,210.6	1,124.1	3,454.9
Hake		141.4	77.9	59.2	50.7	329.2
Ling		41.4	32.3	28.4	55.2	157.3
Plaice	Large	181.8	183.3	157.8	66.0	588.9
	Medium	278.6	493.7	454.4	222.2	1,539.9
	Small	848.0	1,370.4	953.9	397.7	3,570.0
Total		1,308.4	2,047.4	1,657.1	685.9	5,698.8
Saithe		467.5	206.2	291.8	378.0	1,343.5
Sole	Large	59.7	65.9	25.4	38.8	189.8
	Large Medium	67.9	112.5	40.2	59.7	280.3
	Small Medium	25.5	58.4	26.0	42.8	152.7
	Small I	9.9	30.0	23.6	207.5	271.0
	Small II	64.9	64.0	154.9	285.3	569.1
	Small III					
Total		227.9	330.8	270.1	634.1	1,462.9
Turbot		54.0	118.0	83.5	75.3	330.8
Whiting		629.4	596.5	374.4	532.1	2,132.4
Other Species		333.2	371.9	158.7	216.6	1,080.4
Total		5,369.7	5,999.2	5,139.5	4,597.0	21,105.4

are fairly well distributed along a faintly curved line (in drawing this line we took into account the relative reliability of the points, because the different ships gave a very different number of observations). This line has been accepted as giving the true relation between horse power and relative fishing capacity. In this way the total fishing effort per month could be expressed in fishing capacity units, and the mean catch per days absence per month could be calculated for an imaginary ship of standard capacity. This gives the graphs of Figures 9 A and 10 A. These graphs do present a truer picture of the course of the fish stock. We now see that the increase of the catches in the second half of 1949 has been caused completely by the bigger fishing capacity of the mean trawler, the fish stock still being declining.

The graphs of the different fish species show many gaps, because often there were no

trawlers fishing in the areas from which the figures had to be calculated. (These graphs have been omitted from this paper). As a consequence the figures of Table 3 are not

Table 2. Catches of Steam Trawlers fishing from the Port of IJmuiden in 1949.

Month	No. of days absence	Quantity landed tons	Quantity per days absence kg.
January	51	58.6	1,149
February	239	346.7	1,415
March	395	554.8	1,405
April	105	98.5	938
May	107	170.5	1,593
June	123	261.4	2,125
July	82	192.3	2,346
August	35	57.6	1,646
September	0	0	—
October	11	20.7	1,881
November	135	239.6	1,829
December	39	48.2	1,235
Total year	1,322	2,048.9	1,549

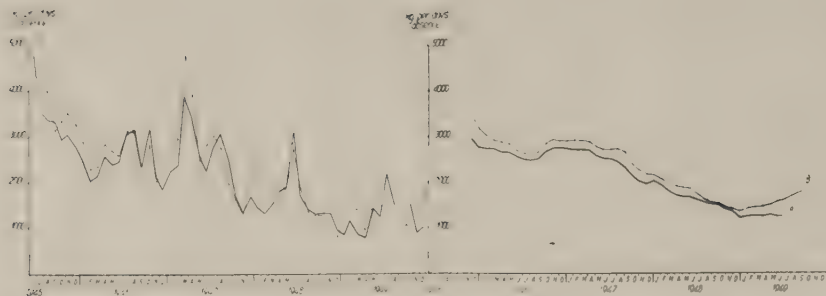


Figure 9. Mean catch per days absence by Dutch steam trawlers (B) and by an imaginary standard ship (A).

Figure 10. Moving average, calculated over periods of 12 months, of the catch per days absence by Dutch steam trawlers (B) and by an imaginary standard ship (A).

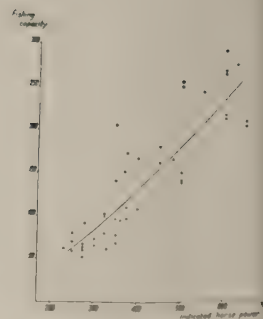


Figure 11. Relation between indicated horsepower and relative fishing capacity of Dutch steam trawlers.

Table 3. Mean Catch (in kg.) per 100 hours fishing of Steam Trawlers at IJmuiden in 1949.

Cod	kg.	Haddock	kg.
Large	1578	Large	494
Medium	88	Medium	1515
Small	182	Small I and II	728
Total	1848	Total	2737

Plaice		Sole	
Large	230	Large and Large Medium	22
Medium	328	Small Medium	10
Small	258	Small I	57
		Small II and III	46
Total	816	Total	135

quite comparable with previous years, but they are sufficient to give an impression of the course of the different species.

The figures of the Dutch 120–240 h.p. motor cutters (Figs. 12–15) do give some additional information. These vessels are mostly fishing within a distance of about 80 miles from the Dutch coast. In combining the data of the trawlers and the cutters we may draw some conclusions about the fish species.

Figure 12 shows that the decline in the total catch per days absence is less in the cutters than in the trawlers.

The total landings of cod remained at the level of 1948. The catch per 100 hours fishing of the trawlers shows a rise in the large fishes a decline in the small ones (Table 3). This

might be related with the change in the fleet. The cutters show some rise in the medium fishes, a decline in the small ones and a steady level for the large ones (Figure 13). Notwithstanding the variations, the general impression is that the cod has not changed very much.

The haddock (Table 3) shows a further decline as compared with 1948. The last half of 1949 seems to give a recovery in the youngest market category, which resulted in bigger landings. Most of the small haddocks have been caught by trawlers fishing for herring and mackerel. The annual average of the

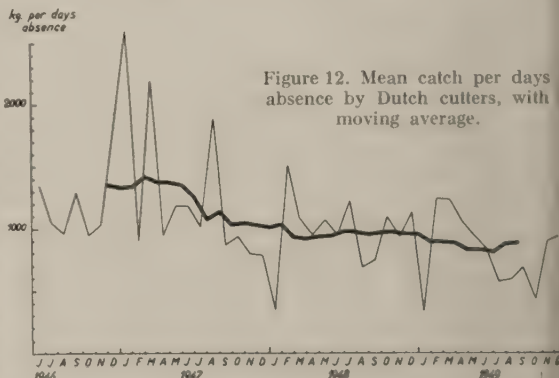


Figure 12. Mean catch per days absence by Dutch cutters, with moving average.

Table 4. The Landings of the Class "Small" in 1949, expressed as a Percentage of the Total.

Quarter cm.	A. IJmuiden						B. At den Helder			
	Cod	Haddock		Plaice	Sole		Plaice			
	< ± 72	< ± 44	< ± 30	< ± 40	< ± 29	< ± 26	< ± 40	< ± 27		
1st.....	17	85	24	86	65	33	29	94	71	
2nd.....	32	85	48	91	67	28	19	97	74	
3rd.....	61	92	71	91	58	66	57	96	64	
4th.....	70	94	71	90	58	78	45	95	60	
1949.....	43	90	61	90	63	57	39	96	67	
1948.....	44	81	25	91	63	23	12	95	70	

S. North Sea
Demersal Fish

kg. per 100 hours
fishing

1000

→ 4150

COD

— Total, — > 72 cm.,
— < 55 cm., - - - 55—72 cm.

J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1946 1947 1948 1949

10000

PLAICE

Total
— < 27 cm.
— 27—40 cm.
— > 40 cm.

J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1946 1947 1948 1949

3000

SOLE

Total

< 26 cm

26—29 cm

> 32 cm

29—32 cm

J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1946 1947 1948 1949

Figures 13—15. Catch per 100 hours
fishing of Dutch cutters.

Table 5. Quantities (in tons) of Demersal Fish landed in 1949 at the Port of den Helder.

Species	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill	0.8	7.2	6.3	2.3	16.6
Cod	6.9	4.0	3.1	5.2	19.2
Dab	107.1	103.6	26.6	27.2	264.5
Flounder ...	27.4	18.0	24.1	4.4	73.9
Plaice Large	5.3	3.8	7.4	4.1	20.6
Medium	21.0	31.5	53.6	31.1	137.2
Small	55.1	98.6	106.6	52.7	323.0
Total	91.4	133.9	167.6	87.9	480.8
Sole	12.4	49.9	57.5	83.7	203.5
Turbot	1.0	4.3	7.9	5.3	18.5
Whiting	35.8	19.2	11.4	40.3	106.7
Other Species	0.5	7.4	8.4	1.8	18.1
Total	283.3	347.5	312.9	258.1	1,201.8

catches in 1949 of these small haddocks per 100 hours fishing with the common otter-trawl are still much lower than in 1948.

The landings of plaice show a decline in all categories, as do the catches per 100 hours fishing of trawlers and cutters (Table 3, Fig. 14).

The landings of soles did increase considerably, especially by big quantities of small ones. The catch per 100 hours fishing of the larger fishes shows some decline, but the figure for small fishes rose very much (Table 3, Fig. 15). These small fish will mainly have belonged to the year-class 1947.

The fixed boundaries of the market categories have been removed. The comparison of the percentage of fish belonging to the categories "small" with previous years is therefore less reliable than before. Table 4 gives the impression that the percentages of small cod and plaice have remained constant, those of small haddock and soles have increased.

L. K. BOEREMA.

A Report on Recent Changes in the English North Sea Demersal Fisheries.

The great reduction in North Sea fishing during the second world war allowed the overfished stock of demersal fish to recover; an increase in its weight density of rather more than threefold was observed (1).

With the resumption of fishing after the war the density of demersal fish, and particularly of the larger individuals of some species, was soon considerably reduced (1, 2). This decline in stock has continued, as is illustrated by the figures for landings by

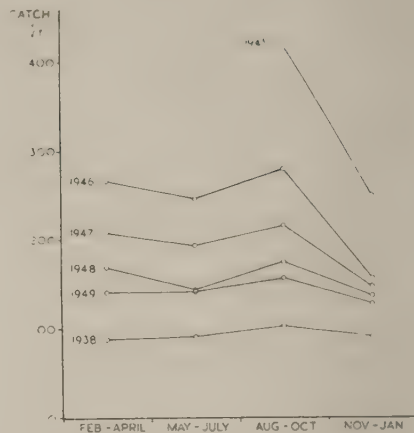


Figure 16. Weight of Catch for an average eight-day Trip of Grimsby North Sea Trawlers, in three-Month Seasons.

Grimsby North Sea trawlers (Table 6, Fig. 16). Grimsby trawlers catch about half of the total English catch of North Sea demersal fish.

The numbers of vessels fishing in the North Sea are not known, but a useful index of fishing effort is provided by the figures for the total hours fishing. The English North Sea fishing fleet has been reassembled steadily since the war but the fishing effort has not reached the pre-war level. Table 7 shows that the trawling effort, as gauged by the time spent fishing, was, in 1949, only 60% of that in the years immediately before the war; it also shows that the post-war re-expansion of the fleet had, by 1949, slowed down considerably.

Two notable features of the constitution of the post-war fleet are firstly, that, although the steam trawler is clearly still the most important fishing unit, motor trawlers are steadily contributing more and more toward the total fishing effort, and secondly, that the method of fishing by Danish seine is becoming more popular and important.

Table 6. Average catch of demersal fish per 8-day trip of Grimsby North Sea trawler.

Year	Feb.-April cwt.	May-July cwt.	Aug.-Oct. cwt.	Nov.-Jan cwt.
1938/39	88	92	103	91
1945/46	—	—	425	250
1946/47	266	246	280	157
1947/48	208	194	216	147
1948/49	169	144	175	137
1949/50	141	142	157	128

Table 7. English fishing effort in the North Sea.

Year	1000 Hours Fishing				Danish-Seiners			
	Trawlers		% Motor	Steam	Motor		% Motor	Total
	Steam	Motor			Motor	Total		
1923	2,757	23	0.8	325	10	335	3.0	
1930	1,837	20	1.1	63	6	69	8.2	
1937	1,486	87	5.5	18	28	46	61.0	
1938	1,262	97	7.2	21	20	41	48.2	
1946	663	31	4.5	19	22	41	54.6	
1947	730	62	7.8	11	39	50	77.8	
1948	753	98	11.5	7	58	65	89.4	
1949	734	141	16.1	6	67	73	91.8	

The steam trawling effort, between 1947 and 1949 inclusive, stood approximately constant at about 55% of its pre-war level while the motor trawling effort increased. The motor trawling effort reached its pre-war level in 1948 and exceeded it in 1949 when it contributed 16.1% of the total North Sea trawling effort, as compared with only 4.5% in 1946 and 5.5% and 7.2% in 1937 and 1938 respectively. It is also noteworthy that the pre-war fleet of motor trawlers contained a large proportion of vessels that were originally built as sailing smacks and later modified and fitted with diesel motors—a class of vessel now obsolescent. The present-day motor trawling fleet consists almost entirely of vessels designed and built as motor trawlers. Of the English North Sea trawlers built since the war, all have been motor powered and none steam powered. But even in 1949, steam trawlers provided as much as 83.9% of the total North Sea trawling effort and caught 83% of all the North Sea demersal fish landed in England.

The Danish seine was first used on a large scale by English North Sea fishermen in 1921 and thereafter its popularity and use increased rapidly until in 1923 it was the means by which 13.4% of all North Sea demersal fish landed in England were captured. It was then used mainly for catching haddock, which comprised 65% of its catch, plaice comprising only 19%. After 1923 the haddock fishery with

seine nets declined, at first rapidly and later more slowly, while fluctuating with the abundance of haddock, until just before the 1939-45 war it contributed only 29% of the English landings of demersal fish from the North Sea (Table 8). The Danish seine landings in the years between 1921 and 1938 included, on the average, about 50% haddock and 18% plaice. The post-war years have brought a renewed interest and activity in Danish seining with the difference that, as compared with pre-war years, the seiners have concentrated on catching plaice rather than haddock. The proportion of plaice in their catches reached 73% in 1948 when haddock comprised only 3%. The seining effort after the war increased steadily and appears to have been still increasing in 1949. In 1946 seiners caught 3.2% of all the English landings of North Sea demersal fish and this percentage was increased to 7.1 in 1949 when almost one fifth of the English landings of the North Sea plaice were seine-caught.

The decline in the total seining effort between 1923 and 1938 was linked directly with a continual withdrawal of steam vessels from the fleet while the motor seining effort increased steadily. In 1923, 98% of the English seining effort was contributed by steam vessels, mainly drifters, but by 1937 the constitution of the fleet had so changed that motor and steam vessels each contributed about half of the total effort. The change-over from steam to motor seiners continued even more rapidly after the war, the motor seiners' share of the total seining effort increasing from 55% in 1946 to 92% in 1949.

Table 8. Composition of North Sea Danish seine catches landed in England.

Year	% Haddock	% Plaice
1921.....	61	22
1923.....	65	19
1930.....	55	13
1937.....	42	14
1938.....	31	18
1946.....	11	57
1947.....	12	58
1948.....	3	73
1949.....	1	71

Reference.

- (1) MARGETTS, A. R. and HOLT, S. J. *Proc. Verb. Vol. CXXII*. 1948 (pp. 29 and 44).
- (2) BOEREMA, L. K. and COX-HEIKENS, M. C. *Ann. Biol.*, Vol. IV. 1949 (p. 100).

A. R. MARGETTS.

Whiting.

Merlan (*Gadus merlangus* L.).

Des mensurations de merlans ont été effectuées du 18 Septembre au 27 Novembre 1949, à bord du «Président Théodore Tissier» et d'un chalutier Français, sur quatre fonds de pêche du sud de la Mer du Nord et du Pas-de-Calais: au «Little Fisher Bank», près de «Old Devil Hole» au «Silver Pit» et à la «Bassure de Baas», près de Boulogne s/Mer.

Les résultats de ces mensurations (au nombre de 1144) sont donnés ci-dessous, en pourcentages.

I - Répartition des tailles (%).

Origine: Little Fisher Bank		Silver Pit	Bassure de Baas
56° 52' L.N. — 6° 20' E.G.	56° 49' N. 0° 06' E.G.	54° 07' L.N. 1° 40' E.G.	50° 29' L.N. 1° 32' E.G.
Sonde: 50 mètres	80 mètres	80 mètres	
Date: 18/9/49	13/10/49	16/10/49	27/11/49
Engin de pêche: chalut de 22 m.	Chalut 22 m. «P.T.T.»	Chalut 22 m. «P.T.T.»	Chalut 18 m. Obs. ANCELLIN
«Président Théodore Tissier»			
Taille en cm.			
14	—	—	0.2
15	0.2	—	0.5
16	—	—	0.5
17	—	—	2.2
18	0.4	—	2.8
19	1.3	—	4.3
20	3.8	—	8.6
21	6.5	5.3	18.6
22	7.5	8	19.5
23	12.8	14.2	16
24	16.3	10.7	7.4
25	17.7	13.3	4.3
26	9.7	8	9.8
27	7.2	8	10.6
28	5.9	8	13.1
29	2.9	6.2	18.4
30	2.5	6.2	15.5
31	0.6	5.3	6.5
32	1.3	1.7	9
33	0.6	3.5	4
34	0.4	0.8	2
35	0.2	—	1.2
36	0.2	—	1.2
37	—	—	0.4
38	0.2	—	—
39	0.2	—	—
40	0.2	—	—
41	—	—	—
42	—	—	—
43	—	—	—
44	—	—	—
45	0.2	—	—
nombre	440	112	244
mode	25 cm.	23 cm.	29 cm.

II - Observations sur le stock.

Il résulte de ce tableau que le stock de merlans à l'automne 1949 était de plus petite taille dans le Pas-de-Calais qu'en Mer du Nord; en Mer du Nord, les merlans étaient plus gros au «Silver Pit» que dans les deux autres secteurs prospectés.

Dans le Pas-de-Calais 70% des poissons capturés mesurent 20 à 24 cm. (mode: 22 cm.). Ces tailles correspondent à des individus du groupe I; ce sont des merlans âgés de 1 an et demi qui prédominent sur la pêche.

Au «Little Fisher Bank», 77% des exemplaires mesurent 21 à 27 cm. (mode: 25 cm.) et à «Old Devil Hole», 70% mesurent 22 à 28 cm. (mode: 23 cm.). Il s'agit là encore d'une majorité de poissons âgés d'un an et demi; conformément aux travaux de FULTON (1901) en baie d'Aberdeen, de DAMAS (1909) dans les fjords du sud de la Norvège, de SAEMUNDSSON (1923) en Islande et de DESBROSSES (1948) sur les côtes de Bretagne.

Au «Silver Pit», 80% du stock pêché mesurent 26 à 32 cm. (mode 29 cm.) et correspondent à des merlans plus vieux âgés de 2 $\frac{1}{2}$ ans: résultat en accord avec la croissance telle qu'elle a été déterminée par les auteurs précédemment cités.

P. DESBROSSES.

Plaice.

The Danish Plaice Fishery in the North Sea.

The market investigations at Esbjerg carried out by Dr. TÅNING's department of "Kommissionen for Danmarks Fiskeri- og Havundersøgelser" have been continued in March, June, August and October 1949.

Density of the stock.

In the outer parts of the nursery grounds in B₄¹⁾, the density would seem to have decreased from 1948 but this decline must partly be ascribed to a heavy swell from NW. in some of the periods when information was collected, (especially in June), which empirically will diminish the catches. Reports from the fishery indicate that there was a dense stock of small marketable fish on the nursery grounds in the spring months. The density of the stock on the grounds farther out was about

¹⁾ The areas are shown in the map, Fig. 1 Ann. Biol. IV, p. 101.

Table 9. Length Composition of Catches (%).

Area	B 4, S. of Hornsreef		B 4-B 5, N. of Hornsreef		NW. of Terschelling		Clay-deep		Dogger	
	1948	1949	1948	1949	1948	1949	1948	1949	1948	1949
Year	V-VI	VI	VIII	VIII	V-VI	VI	V-VI	VI	V-VI	VI
Month	36	39	32-35	34	33-38	36-38	50	41-45	27	20
Depth, m.	1	1	2	2	2	3	1	2	1	1
No. of catches	1	1	2	2	2	3	1	2	1	1
cm.-group										
27—30	55	65	65	75	70	86	37	48	33	46
31—35	43	35	32	24	26	12	49	25	57	28
36—40	1	—	2	1	3	1	12	18	8	14
41—45	1	—	—	—	1	0.6	2	7	1	11
46—50	0.2	—	1	—	0.3	0.1	0.1	2	0.6	1
51—55	0.3	—	—	—	—	—	—	0.2	0.1	—

the same as in 1948, shown in the figures below, giving the mean weight per landing in tons:

	1948 Sept.	1949 March-Aug.
B ₄	3.5 (7) ²⁾	2.4 (4)
C ₂ , north-eastern	3.6 (3)	3.5 (10)
Dogger Bank	2.2 (8)	2.4 (4)

²⁾ Number of landings.

Length composition of the catches.

From Table 9 it is seen that in 1949 the small plaice were relatively more abundant than in 1948, and that in the central North-Sea both the small and the large plaice were more abundant than in 1948.

Age composition.

Age determination of plaice from one catch from the outer part of B₄ and in two catches from C₂ showed that most of them were of the III, IV and V-groups.

AAGE J. C. JENSEN.

The State of the Southern North Sea Plaice Population during the Years 1948 and 1949.

Market samples of plaice taken at Lowestoft and Grimsby in 1948 and 1949, have given the estimates of the percentage survival rates shown in the bottom row of figures in Table 10. These estimates are based on the average age-composition data and catch of certain age-groups per 100 hrs. fishing by British 1st-class steam trawlers landing at Lowestoft and Grimsby for the two periods 1st April 1948—31st March 1949, and 1st April 1949—31st March 1950. Survival estimates for previous years given by HOLT (Ann.

Biol. Vol. IV), are shown in the same table for comparison.

The data referring to the years 1946/1947 seemed to indicate a decreasing survival with increasing age, whereas, in the period 1948/1949 the converse was true, the lowest survival being that between age-groups V to VI. The extent to which these differences may, for example, be due to sampling variations, or reflect the occurrence of some real phenomenon such as a change in the distribution of fishing intensity on fish of different ages, is a problem which will be receiving attention.

In the figures below are given the average weight of plaice of certain age-groups during the years 1948 and 1949 respectively, these data being obtained from the same market samples as mentioned above. It will be seen that there are no appreciable differences between the two years.

Age-groups	II	III	IV	V	VI	VII	VIII	IX	X	XI
Average 1948	186	215	262	325	398	495	640	749	824	862
weight in g. 1949	188	215	253	324	395	519	630	729	786	832

The charts (Fig. 17) show the average catch in cwt. of plaice per 100 hrs. fishing by British 1st-class steam trawlers in each statistical rectangle of the North Sea for the calendar years

Table 10. Percentage Survival Rates,
calculated as the Ratio of the Catch per 100 hrs. fishing
by British 1st-Class Steam Trawlers, of successive
Age-Groups.

Years	Age-group VI	VII	VIII	IX	X
	V	VI	VII	VIII	IX
1937/36	33	37	40	49	80
1938/37	43	44	56	43	45
1939/38	29	40	55	39	51
1947/46	72	29	18	21	17
1949/48	28	33	47	45	63

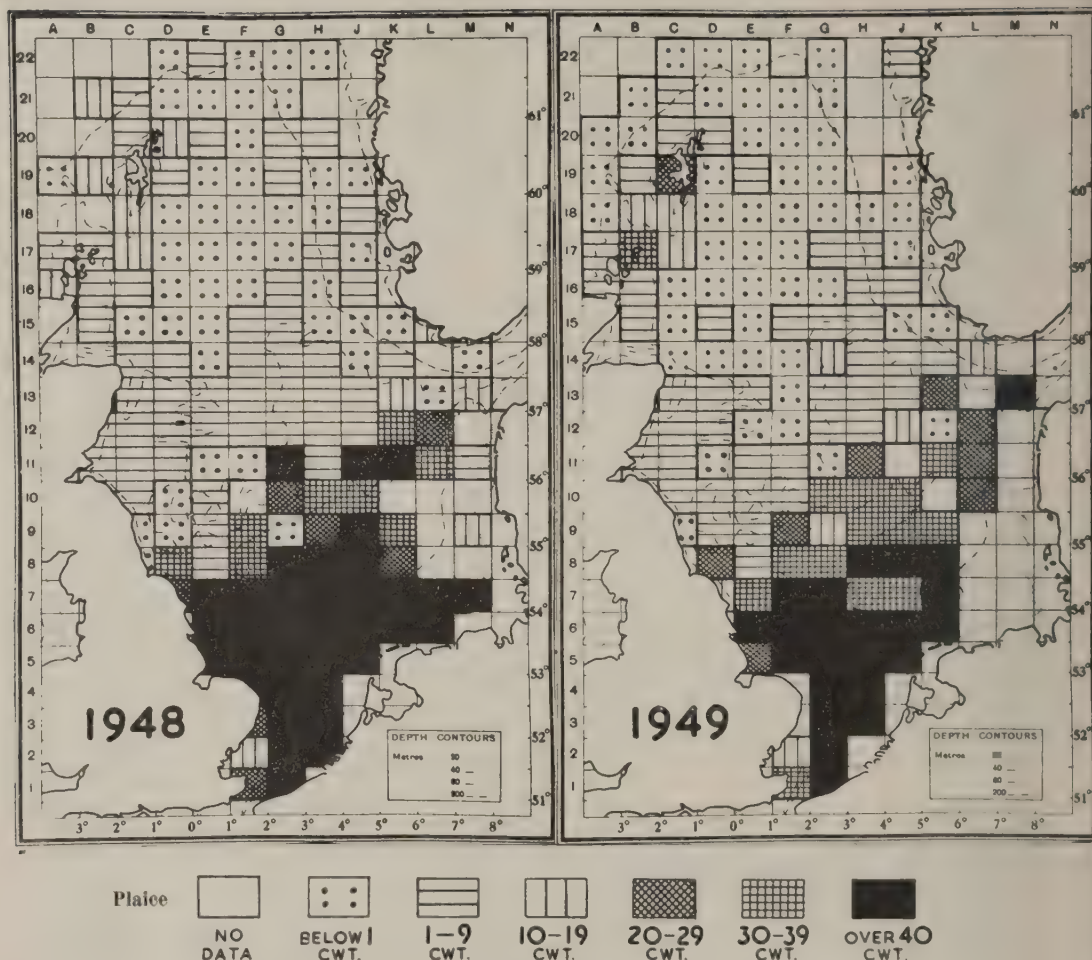


Figure 17. Average Catch of Plaice per 100 Hours Fishing by British 1st-Class Steam Trawlers, 1948 and 1949.

1948 and 1949 respectively. The density distribution of the plaice population is seen to be roughly the same in each year, but the general level of density has decreased to some extent in 1949 compared with 1948, as can be seen from the data below which show the average catch in cwt. of plaice per 100 hrs. fishing by 1st-class steam trawlers from regions IVb and IVc during the years 1948 and 1949.

Year	IVb	IVc
1948	36.4	59.2
1949	27.0	50.0

R. J. H. BEVERTON.

Soles.

The English North Sea Fishery between 1946 and 1949.

Of the total landings of soles in England and Wales over 40% are caught in the North Sea and about 30% in the Irish Sea. The total quantities of soles landed are not large compared with those of some other species but their market value is high; their share of the total quantity of landings in England and Wales is only 0.5% but their share of the value of those landings is four times greater, or about 2.0%.

Within the North Sea, soles are found in appreciable quantities only in the southern part; therefore, in order that indices of density as calculated by catch per 100 hours fishing shall not be misleading, only those statistics relating to approximately the natural habitat of the species will be considered. This, chosen arbitrarily after a review of past statistics, is that region of the North Sea south of latitude $55^{\circ} 30' \text{N}$. Table 11, which contains figures for the catches made by steam trawlers only, shows that the weight density of soles in the southern part of the North Sea, which had increased more than fourfold during the 1939–1945 war (1), declined fairly rapidly between 1945 and 1948 to something like the pre-war level and then increased again in 1949. The 1949 monthly statistics reveal that the post-war decline in density of soles in the North Sea did, in fact, continue during the first seven months of 1949 and then, in the autumn, first of all on the eastern side and later on the western side, there occurred a remarkably

sudden and great increase in both the landings and density of soles (Table 12). The spread of this increased density of soles from east to west across the North Sea during the autumn and early winter months can be followed in the landings from the line of statistical rectangles numbered 7 (Fig. 18). It is usual for catches of soles to increase in the autumn and early winter but not to the same extent as they did in 1949 as is shown by comparing the monthly catches in 1949 with those in 1948 (Table 12) and also those in 1946 and 1947 (2).

As the changes in the density of soles on the east and west side of the North Sea are not simultaneous, and in order to allow for other unforeseen differences between the two sides, the area under consideration may conveniently be divided into two parts, one to the west and the other to the east of longitude 4°E .

The length distributions of samples of soles from catches taken in the western area and measured on Lowestoft market during the

Table 11. Landings of Soles
by English 1st-Class Steam Trawlers
from North Sea S. of Lat. $55^{\circ} 30' \text{N}$.

Year	Landings (cwt.)	Hours fishing	Catch per 100 hrs. fishing (cwt.)
1937	42,382	1,199,458	3.5
1938	27,132	943,871	2.9
1946	73,952	579,473	12.8
1947	55,899	652,706	8.6
1948	17,929	638,473	2.8
1949	21,020	599,932	3.5

Table 12. Catch of Soles
per 100 hours fishing by English Steam
Trawlers from North Sea.

	Eastern ¹⁾ North Sea		Western ²⁾ North Sea	
	1948 cwt.	1949 cwt.	1948 cwt.	1949 cwt.
Jan.	2.9	2.8	7.8	7.9
Feb.	1.7	2.7	5.4	4.0
Mar.	1.0	1.6	4.4	2.2
April	1.4	0.6	1.6	0.9
May	0.2	0.0	0.8	0.3
June	0.5	0.0	2.4	1.0
July	0.8	0.3	1.8	0.6
Aug.	0.8	2.6	2.5	1.3
Sept.	1.1	2.1	4.7	2.5
Oct.	3.3	19.8	3.9	4.0
Nov.	2.8	25.6	6.3	7.7
Dec.	2.3	17.9	5.1	11.6

¹⁾ Statistical rectangles J 7, 8 and K 7, 8.

²⁾ » » » G 4, 5, 6 and 7.

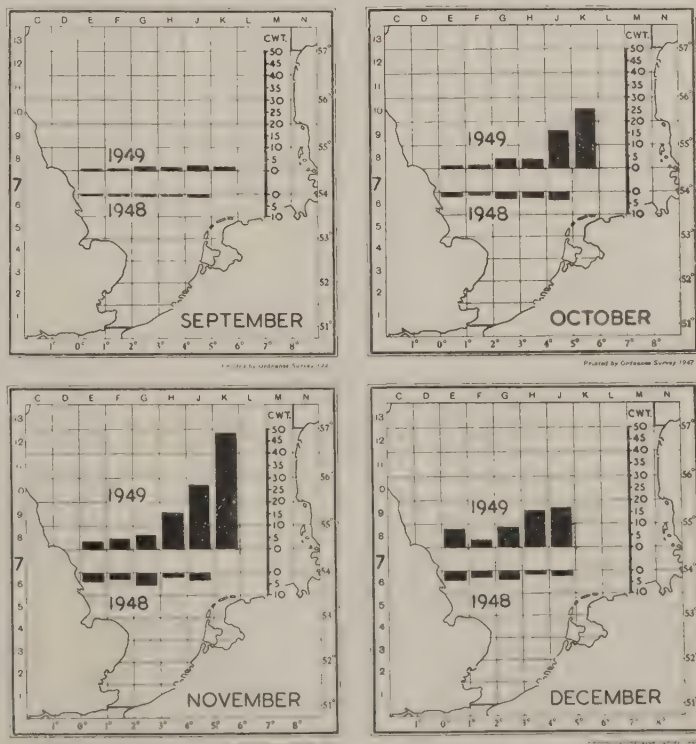


Figure 18. Densities of Soles in statistical Rectangles numbered 7, during last four months of 1948 and 1949, as indicated by Weight of Catch per 100 Hours Fishing by English Steam Trawlers.

second quarter of each year after the war show no very striking changes from year to year. There was a steady reduction in the strength of the modal class which stood at 30–35 cm. in 1946, 31–36 cm. in 1947, 32–38 cm. in 1948 and 35–40 cm. in 1949. The relative abundance of fish of length less than 30 cm. was never very marked, indicating fair or poor recruitment of young fish to the fishery. (Fig. 19). Although the evidence is slight, there is every reason to believe that changes in the eastern area followed the same pattern. In the last quarter of each of the same years the changes in length distributions of samples were similar to those in the first quarter except in 1949. In 1947, samples from the eastern area contained a slightly greater proportion of smaller fish than those from the western area. But the marked changes in length composition of catches at the end of 1949 in both eastern and western areas make it abundantly clear that the increase in catches of soles at that time was a direct result of a sudden recruitment influx to the fishery of

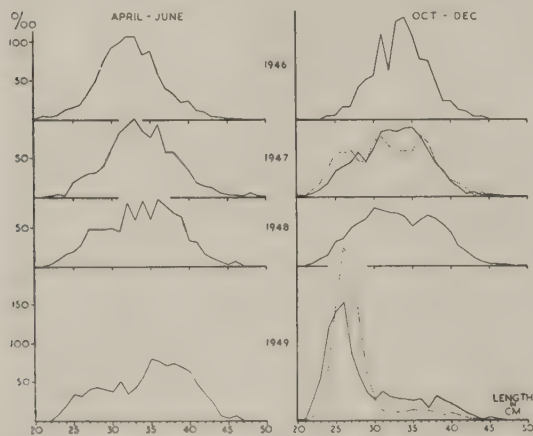


Figure 19. Length Distribution of Soles from eastern (dotted line) and western (continuous line) sides of North Sea in the second and fourth quarters of years 1946–1949.

small fish of length less than 28 cm. A sample of 30 fish typical of the new recruit group (1 at 25 cm., 17 at 26 cm., 12 at 27 cm.) was selected from a catch taken in the western area in December 1949, and the age of each fish determined by examination of the otoliths. Of these 30 fish, 25 were classed as being two years old and 2 as three years old, while the ages of the other 3 could not be determined.

It is rather surprising that, accepting the reliability of the sampling and age determination, the great majority of the unusually large number of recruits to the sole fishery in 1949 appear to be of the 1947 year-class which was probably spawned shortly after the period of exceptionally cold weather in the North Sea.

Conclusion.

After a period of nearly four years during which the sole population of the North Sea was steadily reduced by fishing while recruitment of young fish to the fishery continued at a modest or perhaps sometimes low rate, the recruit group of young soles that entered the fishery in September 1949 brought great increases in catches and timely, if only temporary, increases in the earnings of English trawlers. This recruit group, which was composed largely of fish of the 1947 year-class, appeared to enter the fishery from nursery grounds off the coast of North Holland, Germany and southern Denmark and spread quickly westward. The concentration of fishing effort on this strong recruit group may well have considerably reduced its strength soon after its having left the nursery grounds.

References.

- (1) MARGETTS, A. R. "The Effect of the 1939–1945 War on the English North Sea Trawl Fisheries". *Rapp. et Proc.-Verb.*, Vol. CXXII. 1948.
- (2) WIMPENNY, R. S. "The English Steam Trawl Fishery for Soles in 1947". *Ann. Biol.*, Vol. IV. 1949.

A. R. MARGETTS.

Sprat.

The Use of the Echo-Sounder to chart Sprat Concentrations.

The winter fishery for sprats off the east and south-east coasts of England has failed, during the last two seasons, to produce good returns. A comparison between the landings made during these two seasons and those of seasons before the war (the wartime seasons cannot be used for this purpose because of the closure of many of the grounds habitually fished in this area) shows this failure quite clearly. (Table 13 A).

Whereas all the grounds habitually fished by English boats have yielded greatly reduced catches since the war, it will be noticed from Table 13 B that there has been a very considerable increase in the landings of sprats on the

Dutch coast in the same period. To some extent this increase in total landings gives a false impression because of the increase in number of boats employed in the fishery.

During the last two seasons when the English sprat fishermen have found it increasingly difficult to make a living, there has been news of large concentrations of sprats off the French, Belgian and Dutch coasts and records have been received from time to time both from our own research ships and also from commercial ships, of sprats in the deep waters well offshore in the Southern Bight. Also, in January-February, 1948, when the "Onaway" was working in the Thames Estuary and the Straits of Dover, it became obvious from recordings on the echo-sounder that there were some concentrations of sprats which were not being fished.

In Figure 20 the course of the "Onaway" during this cruise is shown and all echo-traces of fish which were obtained along the course have been indicated. Although no quantitative estimate of the traces was undertaken, it was noticed that in the two areas which were being fished by the English sprat boats, there were thinner and far less extensive traces of sprat shoals than in another area near the French coast just south of Boulogne. In each area the echo-traces were identified, by fishing, as sprats, and off Boulogne the sprats were found to be much larger as well as more numerous than those in the Thames. The triangles shown in Figure 20 mark positions at which single, small shoals were recorded. No fishing was undertaken on these shoals and at the time it was impossible to say definitely whether they were sprat shoals or shoals of other fish such as herrings, which might be in the area.

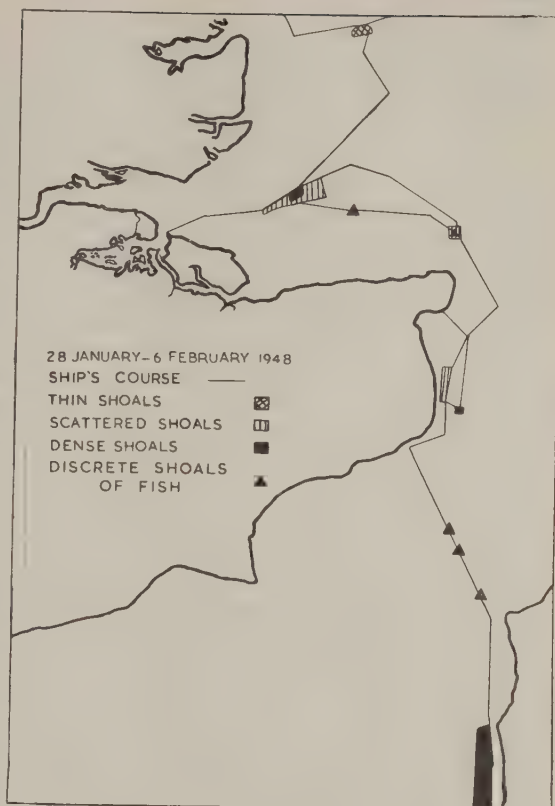


Figure 20.

As a result of research with the echo-sounder, an account of which is in the press, it has been possible to distinguish with considerable accuracy between certain types of shoals and, in the light of our present knowledge, it becomes clear that the shoal marked by a triangle in the Thames Estuary was a sprat shoal, whereas the three triangles found on the cross-Channel run indicated the presence of herring shoals.

As the fishery was still poor during the winter 1949-1950, further cruises were arranged with the object of surveying the Thames Estuary and also most of the Southern Bight by the "Onaway" and the "Sir Lancelot". The echo-sounders were in continuous operation throughout the cruises of each of the ships and the position of each ship was recorded at regular intervals. In this manner a length of echo-sounder paper, divided up into lengths representing known distances along the ships'

Table 13. Landings of Sprats from
English and Dutch Coasts.

	A. England in Cwts.			B. Holland in Kilograms		
	Thames	East Anglia	Kent	North Sea	Laewer Sea	Wad- den Sea
1936..	—	—	—	25	—	32,615
1937..	83,942	11,109	13,308	125	—	—
1938..	46,630	19,445	14,670	37,111	—	325,605
1939..	—	—	—	110	—	42,940
1946..	8,591	11,057	738	33,207	13,548	204,293
1947..	15,894	6,644	227	78,531	176	1,300
1948..	12,599	2,868	508	393,401	464	96,966
1949..	17,841	1,346	466	124,600	3,003	328,742



Figure 21. Cruises of "Sir Lancelot" and "Onaway", 16–29 January 1950.

courses was obtained. Each of these sections was then examined and the total width of any fish traces on that section of paper was measured, and, as the ships were travelling at known speeds, the width of the tracings could be reduced to millimetres per unit of distance. These relative numbers were then marked on the charts of the ships' courses and are shown in Figure 21. The black circles on "Sir Lancelot's" track represent positions fixed by "Decca Navigator". The station positions of the "Onaway" in the Thames are not shown.

Two types of fish trace were recorded on these cruises, one of which was the small comet-shaped trace, so characteristic of sprats. The other was of much larger shoals and covered several centimetres in width and was much more diffuse. This type of trace is

characteristic of the herring shoals which have so often been recorded. These larger, diffuse traces were obtained mainly in two areas which have been indicated in Figure 21. The sprat traces were found mainly in the eastern part of the Southern Bight, and no recordings whatever were obtained at the western-most stations except for a concentration extending from the Galloper eastwards towards the Schelde Estuary.

The heavy concentration of fish off the Dutch coast, as shown by the echo-sounder, agrees with the location of the Dutch sprat fleet, but in the two other areas of equally heavy concentrations, namely, off the Galloper and off the south-east of the English coast near Margate, there was no fishery for sprats. All the usual grounds fished by the English boats

lie in the Thames Estuary and near the shore along the East Anglian and Kent coasts, and except for the area off Margate, it will be seen that there were no records of sprats on the echo-sounder from these grounds. The very small concentration of fish recorded in the Thames Estuary supported a fishery carried on by the stow boats working from local ports, but it will be noticed that this area, to which the relative number 2 has been given, compares most unfavourably with other areas such as those around the Galloper and off Margate, where a relative figure of 100 or over was obtained.

A survey such as the one described above could help to increase the supply of English caught sprats, for it shows, in this instance, that by steaming a short distance further out to sea, the fishermen would have encountered shoals which would undoubtedly have been worth the extra journey.

No explanation for the disappearance of the sprat from the western fishing grounds can be essayed at the moment, but it is thought that a study of the hydrographical conditions of the area, and their possible influence on the movement of fish and/or eggs might help to solve the problem.

I wish to thank Dr. DE BOER who kindly furnished the statistics given in Table 13 B.

IAN D. RICHARDSON.

Black Sea-Bream.

Note Préliminaire sur la Dorade Grise de la Manche. *Spondyliosoma cantharus* (GMEL.).

La dorade grise, ou grisét, est une espèce très estimée des consommateurs Français, spécialement sur les côtes de la Manche; elle a été fort goûtée aussi par les gourmets de la Grèce Antique, bien que nos voisins Britanniques semblent peu l'apprécier (sous le nom de «black sea-bream»).

Sa répartition géographique s'étend de Trondheim à l'Angola et en Méditerranée. On l'a signalée: en Méditerranée de la Grèce à Gibraltar; sur les côtes d'Afrique au sud de l'Angola, et depuis le Cap Blanc et Gorée, les Canaries, Madère, la Péninsule Ibérique, le Golfe de Gascogne, l'Irlande, en Manche, en Mer du Nord au Skagerak, à l'Øresund et jusqu'au fjord de Trondheim.

Les dorades grises sont capturées principalement au chalut et aux lignes à main. La pêche

en Manche a lieu surtout en été et en automne et il est probable qu'elles s'éloignent l'hiver en profondeur. Dans les parages du Cap Blanc, par contre, les captures les plus importantes se font de Décembre à Mars par 90 à 100 m. de fond (CADENAT).

La nourriture des dorades grises est variée et comprend: algues (Fucacées), ophiures, crustacés (en aquarium, elles se montrent friandes de crevettes); elles mordent aussi aux lignes bœttées d'annélides et de moules. Les exemplaires que nous avons examinés en Manche en Octobre et Janvier avaient l'estomac rempli de bras d'ophiures.

La reproduction a lieu en Mai en Méditerranée (LO BIANCO) et vraisemblablement au printemps (de Mars à Mai) en Manche. Nos observations en Manche montrent que l'époque de la maturité sexuelle est encore lointaine en Octobre, mais rapprochée en Janvier (une femelle est au stade V de HJORT). Au mois de Février les ovules sont bien développés (COUCH). Au mois de Juin 1910, le «Thor» a pêché dans le Golfe de Gascogne et près de Gibraltar des larves mesurant 5.5 à 15 mm. que L. FAGE a rapportées à cette espèce. Enfin en Octobre 1933 un jeune de 6 cm. a été trouvé par R. LEGENDRE dans l'estomac d'un germon pêché à 110 milles au large et l'auteur en conclut que l'échantillon «pourrait provenir d'une ponte du printemps».

Alors que les Sparidae ont des œufs pélagiques, l'œuf de *S. cantharus*, sphérique, est déposé sur le fond, dans un trou préparé par le mâle au milieu du gravier ou du sable (Observations faites au jardin zoologique de Francfort par RAFFAELE, 1898).

Les jeunes stades, mesurant 9 mm. à 40 mm. ont été décrits et figurés par S. RANZI en Méditerranée; ceux de 5.5 à 15 mm., par L. FAGE en Atlantique; les descriptions de ces auteurs différant légèrement.

La taille maxima atteinte par l'adulte est d'environ 50 cm.; des exemplaires mesurant plus de 42 cm. ont été signalés sur la côte de Hollande et au marché de Londres; un de 46 cm. a été pêché à la côte Suédoise, d'après NILSSON.

Croissance.

La croissance annuelle de la dorade grise nous semble peu connue. Les seules données que nous ayons trouvées dans la littérature se rapportent à un élevage en aquarium en

Méditerranée; des jeunes mesurant 1 cm. en Juin, ont 15 mois plus tard la taille de 16 cm.; et au bout de 27 mois, en Septembre: la longueur de 24 cm. (Lo BIANCO).

La croissance en aquarium correspond rarement à la croissance des poissons dans leur milieu naturel. Les observations que nous avons faites en Manche indiquent une croissance beaucoup plus lente; une femelle de 29 cm. est âgée de $6\frac{1}{2}$ ans et d'après les stries de l'écaïlle, elle a atteint la longueur de 24 cm. à son 5ème hiver seulement; la majorité des dorades grises atteignent cette dimension, vraisemblablement à leur 4ème hiver et non à $2\frac{1}{2}$ ans comme le montre le tableau ci-contre:

Ainsi les dorades grises pêchées en Octobre 1949 en Manche orientale mesuraient 18 à 23 cm., et étaient âgées de 2 ans et demi. Les mensurations effectuées sur les écaïlles montrent un accroissement moyen de 9 cm. la première année; 6.5 cm. la seconde; 5 à 6 cm. la troisième année.

D'après les premiers résultats, donnés seulement à titre indicatif, et qui seront complétés, la croissance est lente, comparativement à celle des gadidés par exemple, plus lente même que celle de la sole (*Solea solea*) dans la même région.

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Date: 25 Octobre 1949.

Lieu: large du Cap d'Antifer, sonde 40 m.

Navire: «Président Théodore Tissier», Station 359.

Taille en cm.	à L ₁	à L ₂	Taille actuelle
7	1	—	—
8	4	—	—
9	8	—	—
10	6	—	—
11	—	—	—
12	1	—	—
13	—	1	—
14	—	1	—
15	—	8	—
16	—	6	—
17	—	3	—
18	—	1	1
19	—	—	3
20	—	—	12
21	—	—	9
22	—	—	6
23	—	—	1

Taille en cm.	1 an	2 ans	$2\frac{1}{2}$ ans
modale	9	15	20
moyenne	9.1	15.6	20.5
extrêmes	7—12	13—18	18—23

P. DESBROSSES.

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Transition Area.

INTRODUCTION.

Contributions to this report have been received from Dr. ALF DANNEVIG, Norway, Dr. AAGE J. C. JENSEN, Denmark, Cand. mag. J. B. KIRKEGAARD, Denmark, Cand. mag. J. KNUDSEN, Denmark, Dr. ARVID R. MOLANDER, Sweden, Dr. ERIK M. POULSEN, Denmark, Mag. HELGE THOMSEN, Denmark.

A. Environment.

Hydrography. The deviations of the monthly means of salinity and temperature at the surface and on the bottom at the lightvessels "Anholt Nord" and "Halskov Rev" are given in Tables 1 and 2, together with the means, for a series of years. In Table 3 are stated the monthly means of residual surface currents at the L.V. "Halskov Rev".

In the autumn of 1948, and in January and February 1949, the salinity of the surface water was considerably above the normal, during the summer and early autumn 1949, however, it was somewhat below normal; at the bottom the salinity was normal or just below normal for most of the period, except at Halskov Rev where very low salinities occurred in spring.

The temperature was, for the most part, at or a little above the normal, except in the Kattegat, where the surface temperature was ca. 2° above the normal during the winter.

On the Norwegian Skagerak coast (Arendal) the temperature at a depth of 1 m. was very high during the winter, and for all months except August, somewhat above normal.

Thus the year has been characterized by a high winter surface temperature, especially in the northern part of the Transition Area.

Benthic Food. Valuations of the sea-bottom were carried out in the Limfjord and in certain parts of the southern Kattegat and the Belt Sea. In the Limfjord the amount of

1-class food was near the normal. *Mytilus edulis* and *Ascidella aspersa* continues to be very abundant.

B. Fish.

Eggs and Larvae.

Investigations with the ring-trawl in Danish waters in April and May showed an abundance of flounder larvae but a scarcity of plaice larvae. The number of larvae of cod was on a whole above the normal. A few haddock larvae were found as far south as in the S. Kattegat.

In the Belt Sea and the S. Kattegat the number of larvae of spring spawning herring was normal, that of the autumn herring, however, much below the normal.

Older Fish.

Cod. Following the rich occurrence of larvae in spring the abundance of 0-group cod was considerably above the normal in the Kattegat and in the Belts. The number of cod of 1-group and older was, on the whole, below the normal.

Along the Norwegian Skagerak coast and in the Oslo Fjord, however, the 0-group was very poor.

Whiting. The abundance of whiting, a species which plays a very big role in the waste fish fishery of the N. Kattegat and the Skagerak, has been investigated. On the Norwegian Skagerak coast the density of 0-gr. fish was about normal, but 3 times the normal in the Oslo Fjord. The 0-group was also rich in the Kattegat. Until now no decline in the stock as a whole has been observed, in spite of the heavy fishing during later years.

Plaice. The number of 0-group plaice on the Swedish and the Danish coasts was somewhat below the normal (Fig. 1). However, considerable quantities of 0-gr. fish were found in September in deeper water (8—

13 m.) in the southern Kattegat and the Belts. Whether the occurrence of 0-gr. plaice in deeper water is as unusual as former researches suggest, is a question which must be investigated further.

Racial investigations have shown a strong immigration of young plaice from the northern Kattegat to the southern Kattegat and to the Belt Sea, but also given some evidence for a migration from the south to the north.

In the Limfjord the stock of plaice is still decreasing; the 0-group was, however, a rich one. In accordance with the scarcity of the stock the growth was better than in the previous years.

The market measurements in Danish ports were continued.

As usual, transplantations of young plaice from the western Limfjord to the central Limfjord and the Belt Sea were carried out.

Turbot and Flounder. Their occurrence on the Danish and Swedish coasts was investigated.

Marking experiments with turbot were carried out in the Limfjord, where only smaller turbot occur, in order to ascertain whether the stock is local or whether migrations to or from other waters take place.

Dab. Investigations on the density, growth, and racial characters were carried out in Danish waters.

Fish for Processing.

In view of the big fishery for fish for processing in later years special investigations were carried out in order to ascertain the influence of this fishery upon the stock of the food fishes. In the Skagerak, the Kattegat, and the Belts, over half of the fish caught for processing consists of young whiting, and roughly $\frac{1}{3}$ of young herring and sprat. Young plaice, cod, haddock and mackerel only play a very small role, only some 3—4% in all.

Rearing Experiments.

The experiments at Flødevigen of cod, plaice and herring larvae were successful.

Crustacea.

The investigations especially concerning the stock of deep sea prawn and Norwegian lobster in the Skagerak and the Kattegat were continued.

ERIK M. POULSEN.

ENVIRONMENT.

Hydrography.

1. Kattegat and Belts.

Table 1. Monthly Means of Salinity at Surface and Bottom at the Lightvessels "Anholt Nord" (A) and "Halskov Rev" (H) for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Surface													
	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
A Mean.....	20.7	21.9	22.8		23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7
H Mean.....	16.2	16.3	15.6		16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6
A 1948.....	5.9	2.9	1.3	1949	2.7	2.9	2.2	0.7	1.0	0.3	-1.3	2.0	-4.0
H 1948.....	2.9	0.5	1.1	1949	3.0	4.0	1.4	2.4	0.3	-0.8	-1.3	1.2	-3.7
Bottom													
A Mean.....	32.2	32.4	32.1		31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8
H Mean.....	23.3	21.5	22.1		21.9	21.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7
A 1948.....	-0.6	0.0	0.5	1949	0.1	0.1	0.4	0.7	-0.1	0.4	1.2	-1.1	1.0
H 1948.....	-1.4	-2.7	-1.1	1949	1.5	-1.2	-7.9	-4.8	-1.2	0.2	0.7	-1.8	3.0

Table 2. Monthly Means of Temperature at Surface and Bottom at the Lightvessels "Anholt Nord" (A) and "Halskov Rev" (H) for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Surface													
	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
A Mean.....	10.9	7.1	4.1		2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5
H Mean.....	11.1	7.3	4.0		2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5
A 1948.....	0.7	0.8	1.9	1949	2.1	1.8	0.6	1.1	1.2	0.1	1.9	—	—
H 1948.....	0.1	0.4	0.7	1949	0.7	0.4	—0.5	1.2	1.0	1.3	1.8	0.1	2.6
Bottom													
A Mean.....	12.1	10.2	8.1		6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1
H Mean.....	11.6	8.4	5.9		3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2
A 1948.....	1.0	0.8	0.8	1949	1.0	1.0	1.1	1.2	0.8	0.2	-1.7	—	—
H 1948.....	0.1	0.7	0.2	1949	0.2	—0.9	—1.4	0.4	0.7	0.3	—0.5	0.7	—0.2

Table 3. Monthly Means of Residual Surface Currents in cm. sec. at the Lightvessel "Halskov Rev". The Current from the Baltic is stated as positive, towards the Baltic as negative.

(From the Danish Meteorological Institute, Nautical Department.)

1948	X	XI	XII	1949	I	II	III	IV	V	VI	VII	VIII	IX
	16.7	15.4	13.6		5.7	-0.1	44.7	-5.9	13.8	16.6	-4.9	21.5	9.4

HELGE THOMSEN

2. Norway. Coast of Skagerak.

The sea-temperature near Arendal at a depth of one metre was extraordinary high during the winter, and above normal for all months except August.

Average	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919—45	3.04	1.96	2.24	4.53	9.0	12.91	16.19	16.52	14.45	11.22	7.69	5.09
1946	3.4	2.8	1.4	5.0	10.8	12.9	16.8	16.6	15.3	11.3	7.8	5.2
1947	1.3	-0.2	-0.1	3.7	11.3	14.2	17.0	19.7	16.7	12.9	8.3	5.9
1948	2.6	1.6	2.8	6.3	10.5	13.4	16.6	17.3	14.7	11.3	7.9	6.7
1949	5.4	4.5	3.2	5.1	9.7	13.1	17.6	15.8	16.4	12.6	9.0	7.2

ALF DANNEVIG

Benthic Food.

Valuation with the PETERSEN grab (0.1 m.²) were carried out as usual in the Limfjord and for the first time since the war bottom samples were also procured from other parts of the Transition Area.

The subjoined table gives the weight (g/m.²) of bottom invertebrates in the two largest broads of the Limfjord: Livø Broad and Nissum Broad. Investigations were carried out in June (S.) and September (A). In both months 20 samples were taken in each broad.

	Livø Broad			Nissum Broad		
	1st class	2nd class	non-food	1st class	2nd class	non-food
A. 1948	12.6	2.5	1318	17	13	497
S. 1949	26	5.5	1060	4.6	36	76
Mean	19	4	1189	11	25	286
1926—46	20	22	260	9.4	119	79

It appears that while in both broads the amount of 1st-class fish food is about the average value for the period 1926—46, the amount of 2nd-class food is small in relation to the same period. The group non-food (comprising especially *Mytilus* and *Ascidella aspersa*) as has now been the case for several years, is considerably above the average value for the period 1926—46.

The valuations carried out in the other parts of the Transition Area have been compiled in Table 4.

Table 4. Weight in g/m.² of Bottom Invertebrates.

For explanation of the terms 1st-class food etc. vide Ann. Biol. III, p. 86.

Locality	No. of samples	1st-class food	2nd-class food	non-food
Flensborg Fjord—Southern Lillebelt. . .	45	33	17	322
C. Kattegat (Ålborg Bay)	15	149	5.4	184
Isefjord	20	3.8	44	0

It is seen that in the Ålborg Bay a large quantity of 1st-class food was found¹⁾, while in Flensborg Fjord—Lillebelt only moderate quantities were present. In contrast to these two districts the Isefjord was poor in 1st-class food. 2nd-class food was rather poor in the C. Kattegat; considerably more was found in Flensborg Fjord—Lillebelt and large quantities in the Isefjord. The group non-food (consisting mainly of *Mytilus* and *Cyprina*) was extremely rich in Flensborg Fjord—Lillebelt, much less abundant in the C. Kattegat and absent in the Isefjord.

JØRGEN KNUDSEN.

¹⁾ Due especially to a rich occurrence of *Macra subtruncata*

THE FISH

Eggs and Larvae.

Gadidae. During spring and autumn, fishing experiments with 2 m. ring-trawl were resumed after a break in these investigations since the beginning of the war. The mean number of codfish larvae per 1 hour in May are shown below. The figures in brackets state the corresponding means for the 5-year period 1935—39.

Area	No. of Stats.	Cod	Whiting	Haddock	Coalfish	Pollack
S. Kattegat	10	86 (25)	14 (0)	0.3 (0.6),	0.6 (0)	3.4 (0)
Sound....	8	28 (15)	0 (0)	0 (0)	0 (0)	0.4 (0)
Belt Sea..	5	60 (60)	0 (0.6)	0 (0.04)	0 (0)	0 (0.04)

In April a mean of 103 cod larvae were taken per 1 hour at 20 stations (mean for 1935—39, 142), and no other Gadidae larvae.

The number of cod larvae in the Belt Sea is normal, but in the southern Kattegat and the Sound it is considerably above normal. Some whiting and a few haddock larvae were caught in the southern Kattegat in May, as well as a few pollack and coalfish larvae.

Flat Fish. The number of flat fish larvae caught in 2 m. ring-trawl per 1 hour were as follows (in brackets, means for 1935—39):

Area	Month	No. of Stats.	Plaice	Flounder	Dab
Belt Sea....	April	20	0 (0.6)	0.5 (1.4)	0 (4.8)
S. Kattegat..	May	10	0.6 (2.4)	21 (1.8)	0.3 (20)
Sound.....	"	8	0 (0.4)	27 (2.2)	0 (1.6)
Belt Sea....	"	5	0 (0.2)	6.2 (1.0)	0 (4.4)

The number of plaice larvae is below normal, but the number of flounder larvae is considerably above normal, especially in the southern Kattegat and in the Sound. A few dab larvae were caught in the southern Kattegat in May, and the mean number is well below normal.

J. B. KIRKEGAARD.

Gadidae.**1. Danish Waters.****Cod.**

Fishing experiments were carried out in Danish waters from April to October with the eel-tog (a small-meshed seine). The number of cod of the various age-groups caught per 1 hour in the different areas are given in the Table 5.

The 0-group is far more numerous than usual in the northern and central Kattegat and also in the Belts. In the southern Kattegat and the western Baltic no specimens of the 0-group were caught, but as very few hauls were made in these areas during the months when the 0-group can be found on the bottom, the figures from these areas are of no importance. There is therefore no doubt that the 1949 year-class is a rich one in the waters within the Skaw.

The number of 1-gr. cod was everywhere below or even far below the normal, and the 1948 year-class must consequently be regarded as poor.

Table 5. Number of Cod caught per 1 hour in the Eel-Tog.

The figures in brackets state the means for the 10-year period 1930—39. For the 0-group only catches made after 1. June are considered.

	No. of Stats.		All age- groups	0-Gr.	I-Gr.	II-Gr.	III-Gr.	IV-Gr.	V-Gr.	VI+ -Gr.
	Apr. -Oct.	June -Oct.								
Skagerak.....	10	10	0.4 (2.1)	— (0.6)	0.2 (1.1)	0.2 (0.4)	0 (0.1)	0 (0.05)	0 (0.02)	0 (0.02)
N. Kattegat....	26	26	7.9 (11)	3.4 (1.8)	4.2 (4.6)	0.3 (2.8)	0 (1.2)	0 (0.1)	0 (0.02)	0 (0)
C. Kattegat....	10	10	312 (45)	312 (47)	0.2 (4.0)	0 (2.0)	0 (0.4)	0 (0.2)	0 (0.04)	0 (0.02)
S. Kattegat....	12	2	5.7 (31)	0 (16)	3.0 (15)	1.2 (3.2)	1.0 (1.2)	0.5 (0.4)	0 (0.4)	0 (0.04)
Sound.....	4	0	29 (69)	— (13)	8.0 (24)	15 (24)	5 (9.0)	0.5 (2.0)	0 (2.2)	0 (0.3)
Belts.....	47	38	103 (38)	90 (32)	6.0 (12)	5.4 (4.6)	1.0 (3.0)	0.1 (0.8)	0 (0.2)	0 (0.1)
W. Baltic.....	4	4	0 (25)	0 (2.4)	0 (16)	0 (4.0)	0 (2.6)	0 (0.4)	0 (0.6)	0 (0.02)

The number of cod of the older year-classes were, on the whole, below the normal. As no investigations were carried out during the war years or the years just after the war, when these year-classes appeared, it is difficult to say whether they are to be regarded as poor year-classes or whether their numbers have subsequently been reduced by other causes. There is a possibility, for example, that the scarcity of the older year-classes (II—IV groups) may be due to a more intense fishery for the smaller cod, owing to the rising demand for small and medium-sized cod for the filleting industry during the last decade.

Racial Investigations. Some of the cod caught during the experimental fishing with the eel-tog were analysed for number of vertebrae and second dorsal fin rays: —

		Mean 1927—49, all age-groups	
Vert. S.:			
Belt Sea . . .	0-Gr. 51.98 (63 ind.)	51.93	
C. Kattegat . .	0-Gr. 52.06 (90 ")	52.13	
Rays D ₂			
N. Belt Sea . .	I-Gr. 18.57 (114 ")	18.44	
N. Belt Sea . .	II-Gr. 18.00 (109 ")		
The Sound . .	I-Gr. 18.62 (13 ")	18.65	
The Sound . .	II-Gr. 18.07 (29 ")		

ERIK M. POULSEN.

Whiting.

During the period April to November numerous hauls with the eel-tog were carried out from S/S "Biologen" in various parts of the area. Whiting were frequently obtained in the catches. The subjoined table gives the number per hour of the various age-groups: —

	No. of Stats.	0-Gr.	I-Gr.	II-Gr.	III-Gr.	Total	Aver. 1927- 39
Skagerak	12	4.0	44	4.0	2.9	55	7.1
Kattegat	42	33	6.1	0.4	0	40	42
Belt Sea	50	2.6	1.0	0.1	0	3.7	12

It appears that by far the majority of the stock in the area consists of specimens of the 0- and I-group. In the Belt Sea the stock was considerably smaller than the average value for the period 1927—39. In the Kattegat the stock was of about normal size. The number of hauls in the Skagerak was too small to give an accurate picture of the size of the stock and it should be emphasized that the average value for the period 1927—39 is also based upon a relatively small number of hauls.

JØRGEN KNUDSEN.

2. Norwegian Waters.

Young Fish.

The ordinary experimental fishing in the littoral region in September and October gave the following average numbers per haul:—

		Cod		Whiting	Pollack
		0-Gr.	I-Gr. ¹⁾	0-Gr.	0-Gr.
Skagerak Coast.					
77 hauls.					
Average	25 years	13.7	1.7	17.8	16.6
	1945	13.0	1.0	65.9	32.8
	1946	1.8	1.1	20.9	3.6
	1947	2.5	0.4	22.6	2.2
	1948	4.3	1.7	19.0	1.4
	1949	1.5	0.7	16.6	3.5
Oslofjord.					
56 hauls.					
Average	6 years				
1936/39,	1945/46	37.9	3.5	13.3	5.4
	1945	92.0	1.2	34.5	16.0
	1946	0.9	9.1	15.3	0.6
	1947	2.4	0.5	16.1	0.9
	1948	7.1	0.4	17.1	1.5
	1949	1.9	1.8	40.6	1.9

¹⁾ A few older specimens included.

The 0-group cod in the littoral region was very scarce. This may, to some degree, be a result of the high temperatures prevailing. The occurrence of whiting is normal for the Skagerak coast, but higher than normal in the Oslofjord.

The experimental fishing with traps at Flødevigen resulted in 128 cod per trap. The 1947 year-class was relatively plentiful.

A sample of cod, $7/_{12}$ 1949, from the skerries to the east of Arendal gave the following number of vertebrae: —

Year-class	1947	20 individuals	52.42 V
—	1948	99	51.90 V

A sample $16/_{12}$ —48 of the 1947 year-class, 139 individuals, had an average of 52.50 V.

ALF DANNEVIG.

Plaice.

1. Coastal Investigations. 0- and I-Groups (Fig. 1).

a) **Danish Coasts.** The number of 0- and I-group plaice and of 0-group flounder caught with the Johansen young-plaice trawl on the coasts in 1—2 m. depth $6/_{7}$ — $3/_{9}$ 1949 are given in Table 6. The number of 0-group plaice was very small. From the surface temperature in January-April which was, on the whole, above

normal, and also from the relatively high surface salinity in the winter and spring months, it was expected that the strength of the 0-group would have been above the mean. Perhaps the strength of the year-class this year is not correctly represented by the coastal investigations on account of the very stormy summer the effect of which has been partly to cause small plaice to accumulate at sheltered places on the coast where they were not seized by the investigations and partly to drive them out into deeper water. Thus at two stations investigated from S/S "Biologen" in the western Kattegat, N. of Djursland, 29 and 853 respectively, 0-group plaice were taken per 30 min. haul with the eel-tog at depths of 8 and 13 m. At some stations in the southern Belt Sea also, considerable quantities of 0-group plaice, 20–29 per 30 min., were taken in the eel-tog at 12–18 m. depths. This occurrence of 0-group plaice at these depths is most unusual.

AAGE J. C. JENSEN.

b) **Swedish Coasts.** The density of 0- and I-gr. plaice (and turbot) was investigated by means of fishing in the coastal areas (depth 0–2 m.) with the Johansen young-plaice trawl at the end of July and the beginning of August.

The stock of 0-group plaice was below the means for the years 1929–38 except in the Sound where it was richer than in any of the years of this period. In the Kattegat the 0-

Table 6. Number of Plaice and Flounder caught per 1 hour on the Danish Coasts.

NB. In previous years per $\frac{1}{2}$ hour. In brackets mean for 1927–49.

	No. of Stations	Plaice		Flounder
		0-Group	I-Group	0-Group
N. Kattegat.	18	36 (68)	0 (46)	0.4 (0.6)
C. Kattegat.	17	2 (27)	0 (8)	0 (1)
S. Kattegat.	16	2 (26)	0 (2)	0 (0.4)
Sound.	15	5 (20)	0 (2)	1 (20)
Belts.	69	5 (25)	1 (2)	0.2 (8)
W. Baltic.	7	0 (12)	0 (0.4)	0 (4)

group was richer than in 1948, but still below the normal. Along the Skagerak coast the 0-group was very poor (see Table 10, p. 151).

ARVID R. MOLANDER.

2. The Stock in the open Sea.

The investigations from S/S "Biologen" gave the number of plaice of the various age-groups shown in Table 7. The unusually large number of 0-group plaice found in the central Kattegat has been explained, see above, by the stormy weather which has driven them out from the coasts. It will be seen that the density of the stock of I-group plaice in the northern Kattegat was somewhat below the normal but in the central and southern Kattegat and in the Belts it was about the normal. From the coastal investigations in 1948 more 0-group plaice than normal were found in the northern Kattegat but less than normal in the more southerly

Table 7. Number of the various Age-Groups of Plaice caught per 1 hour with the Eel-Tog.

In brackets average from 1927–49.

	No. of St.	0	I	II	III	IV
N. Kattegat						
5–14 m.	6	0 (9)	55 (161)	19 (153)	0.7 (44)	0 (1.4)
15–24 "	8	0 (0.2)	59 (76)	18 (117)	0.5 (49)	0 (0.5)
25–34 "	5	0 (0)	3 (3)	6 (29)	1.2 (9)	0 (0.5)
> 35 "	5	0 (0)	1.2 (0.2)	0.8 (1.5)	0 (1.5)	0 (0.4)
C. and S. Kattegat						
5–14 m.	5	358 (3)	21 (20)	2 (15)	0 (1.0)	0 (0.1)
15–34 "	10	0 (0)	1.0 (0.7)	0.0 (0.3)	0 (0.2)	0.2 (0.04)
Belts						
5–14 m.	¹⁾ 3	19 (3)	6 (7)	0.7 (5)	0 (2)	0 (0.1)
5–14 "	²⁾ 3	—	—	—	0.1	0.1
15–34 "	¹⁾ 38	1.1 (0.4)	3 (1.6)	1.0 (1.5)	1.1 (0.6)	0.1 (0.2)
15–34 "	²⁾ 38	—	—	—	0.2 (0.05)	0.1 (0.1)

The number of the 0-group is calculated from investigations after 1. July.

In the Skagerak, the Sound and the western Baltic there are a few stations (2, 4 and 5 respectively) which cannot give representative information for the stock since only very few plaice were caught. In the western Baltic no plaice at all were caught.

¹⁾ local plaice. ²⁾ transplanted (judged from the growth of the otoliths).

waters. This discrepancy between the strength of the 1948 year-class as 0- and I-group respectively, cannot be explained by a southward migration of the young plaice, which would seem to be the most obvious explanation, as the racial analyses have given the number of anal fin rays shown in Table 8.

Table 8. Anal Fin Rays of Plaice.

(Numbers in brackets).

	0-Group in 1948	I-Group in 1949
N. Kattegat ¹⁾	52.41 (528)	51.92 (136)
C. Kattegat ²⁾	50.33 (162)	51.59 (136)
N. Belts ³⁾	50.29 (161)	50.50 (38)

¹⁾ Aalbæk Bay. ²⁾ Hals-Fornæs. ³⁾ Round Samsø and northern Great Belt.

It is seen that the I-group plaice in the northern Kattegat have a more southerly racial character than they had as 0-group, and thus—in view of the lesser density of the I-group—we must conclude that the young plaice of the 1948 year-class which were found here as 0-group have, for the most part, left the area and have to some extent been replaced by fish migrating from the south.

In the central Kattegat the number of anal fin rays of the I-group was appreciably greater than of the 0-group. To this area there must have been a very great immigration of young plaice from the northern Kattegat, causing an increase in the density of the stock. In the Belts also, the stock must have been increased by an immigration from the north.

Moreover it will be seen from the table that the stock of older age-groups is very sparse, corresponding to the poor year-classes 1946 and 1947 found from the coastal investigations in the Kattegat and the poor year-class 1947 in the Belt Sea. The III-group (year-class 1946) in the Belts was more numerous than normal corresponding to the fact that this year-class was found from the coastal investigations in 1946 to be stronger than normal, but the reduction in density caused by the intense fishery has been so great that their numbers are relatively small.

In the northern Kattegat the average lengths of the I and II-group were in July:

Depth	I-group	II-group
5—15 m.	15.5 (164)	22.1 (57)
15—24 m.	17.9 (235)	23.5 (70)
25—34 m.	15.5 (8)	19.7 (14)

In 1927—29 the mean lengths of the I-group and II-group in 5—35 m. depth was 19.3 and

22.6 cm. respectively. It is seen that the mean length of the I-group has decreased, which corresponds to the fact that this year-class (1948) was very much stronger than normal.

AAGE J. C. JENSEN.

3. The Limfjord Stock.

Investigations were carried out by means of the eel-tog in summer (June) and autumn (September). The number of plaice caught per 1 hour in the various parts of the Limfjord are shown below. The numbers in brackets give the average for the period 1927—39:

	Nissum Br.	Veno-Kås	Sallingsund
Summer..	390 (712)	42 (168)	16 (92)
Autumn..	474 (962)	13 (184)	2.0 (24)

	Livo Br.	Thisted-Visby Br.	E. of Salling
Summer..	2.6 (12)	2.6 (24)	0 (10)
Autumn..	0 (4)	0 (8)	0 (2)

The stock was thus far below the normal, and smaller than in 1948. In the Nissum Broad a small increase occurred from summer to autumn. In the inner parts of the fjord the stock was very small, especially in the autumn.

The age composition of the stock in Nissum Broad was as follows (catch per 1 hour):

Age-Gr.	Year-Class	June	September
0.....	1949	0	101 (80)
I.....	1948	138 (152)	193 (448)
II.....	1947	198 (308)	158 (298)
III.....	1946	47 (206)	20 (124)
IV+.....	1945	8 (54)	1.6 (34)

The numbers in brackets give the means for 1927—39. In June the number of I-group fish was a little below the normal and that of fish of older age-groups was far below the normal. In September the numbers of all the age-groups from group I upwards were far below the normal. The 0-group (year-class 1949) was, however, a rather rich one, its number being well above the normal; it is the richest 0-group observed since 1940.

The following figures for Nissum Br. give the mean length in cm. of the age-groups I—III (No. of ind. in brackets) during the period 16.—24. September for the years 1946—49 compared with the density of the stock (total number caught per 1 hour):

Year	I-Gr.	II-Gr.	III-Gr.	Total no. per 1 hour
1946.....	11.7 (385)	16.0 (677)	19.5 (392)	1980
1947.....	13.3 (134)	16.9 (505)	19.9 (310)	1532
1948.....	15.0 (98)	20.5 (114)	23.0 (63)	462
1949.....	13.6 (239)	18.6 (250)	23.7 (32)	474

It is seen that the age-groups attained considerably smaller sizes in the years 1946 and 1947 when the stock was dense than in 1948 and 1949, when the stock was thinner. The III-group, for example, in September 1946 and 47 was only 19.7 cm. long against 23.4 cm. in 1948 and 49.

ERIK M. POULSEN.

4. Market Measurements.

In each part of the western Kattegat the length distribution of the plaice was about the same in 1949 as in 1948 (see Table 9). The average length had increased in 1948 as compared with 1947 while recruitment of the stock of commercial plaice was poor on account of the scarcity of the 1946 year-class. The 1947 year-class was also poor and the stock, as in 1947, contained relatively large numbers of old fish. The number of these had been diminished very much by the intense fishery and the density of the stock was small. The improvement of the stock due to the good 1948 year-class began in the autumn of 1949 in the central and southern Kattegat. In the central Kattegat in October, at the locality mentioned in Table 9, 80% of the plaice were between 26–30 cm. length and the mean length had decreased to 29.5 cm.

In the western Baltic to the south of Langeland the increase in lengths stated in 1948 (see Ann. Biol. V.) has been replaced in 1949 by a decrease, and the mean lengths were about the same as in 1947.

AAGE J. C. JENSEN.

5. Transplantation.

Transplantation of young plaice was carried out in the last half of March, as in previous years, to the Belt Sea and adjacent waters and to the inner broads of the Limfjord.

The plaice were caught by Danish seine in Nisum broad (the westernmost parts of the Limfjord).

Samples of the plaice caught for transplantation were examined as to age, length and number of anal fin rays.

The length- and age-analyses gave the following results:—

Age-Group ¹⁾	I	II	III	IV	V	Total
Year-Class	1948	1947	1946	1945	1944	
Number	2	215	571	298	24	1110
%	—	19	51	27	2	99
Mean Length						
cm.	—	16.38	20.97	23.15	24.62	20.7

¹⁾ Stated as if the fish were caught after April 1st.

Table 9. Length Composition of Plaice (%) in the Kattegat.

Depth m.	No. of Samples	26- 30 cm.	31- 35 cm.	36- 40 cm.	41- 45 cm.	Mean cm.
Near Skagen						
1948, Nov.	21	1	79	20	1	29.4
1949, Nov.-Dec.	20	3	62	32	5	30.1
Central Kattegat c. 20 naut. miles SE. of Hals.						
1948, May.	13	1	30	47	20	33.5
1949, July.	13	1	35	40	25	32.7
Havknude Flak S. of Grená						
1948, March	16	1	48	42	10	31.7
1949, March ...	16—18	2	46	34	19	32.0
Briseis Flak c. 15 naut. miles E. of Hasenore						
1948, March- May.	11—27	3	41	45	13	32.3
1949, May-July	15—23	2	39	48	9	32.1
At Hjelm, near Hasenore						
1948, May.	14	1	49	33	18	32.3
1949, May.	19	1	43	39	18	31.9
c. 10 naut. miles S. of Bagenkop						
1947, May.	23	1	60	34	6	30.3
1949, Apr.-May..	23	2	48	43	7	31.4
1947/48, Dec.- Jan.						
23	2	24	28	44	¹⁾ 2	35.0
1948/49, Dec.- Jan.						
23	2	42	34	15	9	33.2
7—10 naut. miles WSW. of Bagenkop						
1947/48 Dec.- Jan.						
30	2	36	27	25	¹⁾ 10	34.4
1948/49, Dec.- Jan.						
30	2	32	51	14	4	33.1
1947, Apr.						
30	1	52	26	15	7	32.2
1949, Apr.						
30	1	53	40	7	—	31.2
S. of Æro						
1947/48, Dec.- Jan.						
29—32	2	51	26	23	—	32.1
1948/49, Dec.- Jan.						
32—34	2	49	39	8	4	32.8

¹⁾ including 2% of 46–50 cm.

The mean lengths of each age-group were somewhat higher (+2–2.5 cm.) than in the previous year. The mean size for the whole sample was 20.7, a little higher than usual (in 1948, 19.9 and 1947, 19.2). This is obviously due to a better growth during 1948 caused by the fact that the density of the plaice stock in Nisum broad was rather small during summer and autumn of 1948. The large size in

1949 may, however, also be the result of an unusually strong immigration of young plaice from the coastal waters of the North Sea, where the growth is generally somewhat faster than in the Nissum broad.

The analyses of the anal fin rays gave the following results:—

Age-Group ¹⁾	I	II	III	IV	V	Total
Year-Class	1948	1947	1946	1945	1944	
Number of A.	—	53.36	54.00	54.12	—	53.93
Number of ind.	2	215	571	298	24	1110

¹⁾ Stated as if the fish were caught after April 1st.

The 1946 year-class thus has a number of anal fin rays very near the normal, the 1947 year-class was well below and the 1945 a little above the normal.

a) Transplantation to the Belt Sea and adjacent waters. The following figures give the weight and number of plaice transplanted to the various areas:—

	Tons	Thousand Fish
Southern Kattegat and the Isefjord..	8.0	87.6
The Sound.....	4.0	39.2
Northern Belt Sea.....	24.5	257.2
Southern Belt Sea.....	24.1	219.8
Western Baltic.....	4.1	42.0
Total.....	64.7	645.8

The quantities are about the same as in 1947 and 1948.

Samples of the transplanted plaice were marked. Up to the beginning of February 1950 12% had been recaptured; the percentage of recaptures varied in the samples from 4 to 31, the highest percentage being found in the southern Lillebelt.

During the winter of 1949/50 samples of plaice caught by fishermen in various parts of the Belt Sea were examined and showed that 4.1% by weight of the commercial catches consisted of transplanted plaice. The total catch of plaice within the Belt Sea and the adjacent areas to which fish had been transplanted has, during recent years, been about 2200 tons yearly; 4.1% of this gives ca. 90 tons. However, the commercial catch of transplanted plaice is greater in autumn and winter than in spring and summer, but even if we reckon the gain as only half the figure of 90 tons stated above, we get a gain of 45 tons. This 45 tons, at 1.30 øre pr. kg., amounted to 58,500 kr. compared with 45,000 kr. for the cost of the transplantation.

b) Transplantation to the inner broads of the Limfjord. The quantity of plaice transplanted was 100,000 kg. or 1,037,000 individuals. From the samples marked 24% were recaptured up to the beginning of February.

ERIK M. POULSEN.

Flounder and Turbot.

1. Young Fish.

a) Danish Coasts. The number of 0-group flounder was very small but, except in the Sound, they are normally very scarce in the catches obtained by the fishing experiments which are carried out mostly on the open coasts, since young flounder prefer sheltered localities with a mud bottom.

No 0-group turbot were caught in 1949, and only 2 1-group fish in the Belts (a mean of 0.1 per hour). Young turbot are usually absent or very scarce on the Danish coasts.

AAGE J. C. JENSEN.

b) Swedish Coasts. The stock of 0-group turbot (Table 10) was poor in the Skagerak but much richer in the Kattegat and the Sound, where the catch figures were far above the figures for 1948 as well as above the mean figures (1929—38).

Table 10. Number per 1 hour of Plaice and Turbot caught at $\frac{1}{2}$ —2 m. depth.

Plaice	No. of Stats.	Mean				1948	
		1949	1929—38	1948	1948	0-Gr.	1-Gr.
Skagerak...	36	54	2	100	2	112	14
N. Kattegat..	8	123	4	150	2	64	20
S. Kattegat..	28	176	0	192	2	104	4
Sound.....	4	212	0	14	0	26	0
Turbot							
Skagerak...	36	0.2	0	1.2	0.2	0.2	0.4
N. Kattegat..	8	46	0	4	0.2	0	0.4
S. Kattegat..	28	12	0	9	0.8	0	0.2
Sound.....	4	6	0	0	1.0	0	0

ARVID R. MOLANDER.

2. Limfjord Stock.

The number of flounders was considerably below the normal, and for the whole fjord only 1.0 per 1 hour were caught against a mean of 2.6 for the period 1927—46. In the western parts of the fjord the stock was, as in 1948, a little above the normal, but far below the normal in the central part.

The turbot is fairly common in the Limfjord, and in the central parts of the fjord

especially, a turbot fishery of some importance occurs. The turbot of the fjord, however, never grows to the same size as outside the fjord. The question therefore arose as to whether the turbot, as is the case with the plaice and dab, emigrates from the fjord before attaining maturity. In a sample of turbot caught in June 1949 there were, however, some female turbot with ripe eggs (mat. VI). 200 spec. (20—30 cm. of length) were marked in the central part of the fjord on the 19th—24th June 1949. Of these 12% had been recaptured up to 1st February 1950, all in the fjord and fairly near the place of liberation. The growth was rather small, only 2.3 cm. from the end of June to the end of September. A small sample was examined for race-characteristics: Anal fin rays, 45.62 (45 ind.), Vert. S., 30.23 (30 ind.).

ERIK M. POULSEN.

Dab.

1. Danish Waters.

During 1949, fishing with the eel-tog was carried out from S/S "Biologen" at a large number of stations in the area.

The figures below give the number of dabs (all age-groups) obtained per hour in the different parts of the area:

	No. of Hauls	Total Number	No./Hour	Average No./Hour 1930—39
Skagerak . . .	11	304	58	89
N. Kattegat . .	25	2396	213	310
C. Kattegat . .	10	534	125	69
S. Kattegat . .	8	309	93	121
Belts	50	3663	152	176
W. Baltic . . .	5	4	1.8	93

It appears that in all areas except the central Kattegat the stock of dabs was below the average for the period 1930—39. In the central Kattegat the stock was considerably above normal.

In a number of specimens the age was determined by means of examination of otoliths. The figures below show the result of these examinations.

	Total number of specimens examined	I-Gr. %	II-Gr. %	III-Gr. %
Skagerak . . .	304	69.4	28.9	1.7
N. Kattegat . .	2041	76.4	22.3	1.3
C. Kattegat . .	180	80.6	16.6	2.8
S. Kattegat . .	309	70.3	23.0	6.5
Belts	3149	78.2	12.1	9.6
W. Baltic . . .	4	75.0	25.0	0
Total	5987	76.8	17.2	6.0

It is seen that the majority of specimens analysed belong to the I-group while older specimens (III-gr. and older) seem to be comparatively scarce. It should be added that in late summer and autumn a number of specimens of the 0-group were obtained.

Anal fin rays and vertebrae counts were carried out on a number of specimens, all belonging to the II-group (year-class 1947). The counts may be summarized as follows:—

	No. Anal Fin Rays	No. Vertebrae
Skagerak	57.93 (57)	—
N. Kattegat	57.11 (196)	40.60 (136)
S. Kattegat	55.28 (43)	—
N. Belt Sea	54.79 (162)	40.06 (120)

The figures in brackets indicate the number of specimens examined.

As might be expected we find a decrease both in the average number of fin rays and vertebrae from the Skagerak to the Belt Sea.

J. B. KIRKEGAARD and J. KNUDSEN.

2. Limfjord Stock.

The stock of dab in the Limfjord was considerably below the normal, as was also the case in 1945—48, especially in the inner parts of the fjord. The following numbers (means of June and September) were caught per 1 hour in the various parts of the fjord (means 1927—46 in brackets).

Nissum	Venø-	Salling-	Live	Thisted	E. of
Br.	Kås	sund	Br.	Visby Br.	Salling
52 (152)	16 (40)	3.0 (26)	0.8 (2.8)	0 (1.4)	0 (0.8)

A number of I and II-group dab from the Limfjord were analysed for number of anal fin rays and vertebrae:

	Year-Class	Anal Fin Rays	Vert. S.
I	1948	57.19 (33 ind.)	
II	1947	55.80 (95 ind.)	40.23 (73 ind.)

It is of interest to note that the 1947 year-class appears to have a low number of anal fin rays, just as is the case with the same year-class of plaice in the western Limfjord (see p. 151).

ERIK M. POULSEN.

Eel.

1. Limfjord.

The number of eels caught per hour with the eel-tog in 1949 are given below:

(Average for 1929—39 in brackets)

	Nissum Br.	Venø-Kås	Sallingsund
June.....	3.1 (1.8)	2.8 (1.4)	0.0 (2.0)
Sept.....	0.0 (0.4)	0.0 (3.0)	0.0 (3.6)

	Livø Br.	Thisted Br.	E. of Salling
June.....	1.6 (2.2)	0.0 (2.6)	0.5 (2.4)
Sept.....	0.2 (5.0)	0.3 (8.0)	0.0 (5.6)

In the south-western part of the fjord the numbers in June were about double the normal for the 30'ies, in Livø broad they were about $\frac{2}{3}$ of the normal but in the other parts of the fjord they were very small. In September very few were caught, although normally there are more eels in the autumn (except in the Nissum broad) than in June, no doubt on account of the migrations of the silver eels from fresh water to the sea.

In accordance with the low density the yield of the fishery for yellow eels from seine, eel-spear, and hook, as well as from weels and pound-nets (mostly yellow eels and eels which become yellow during the autumn) was below the mean for the previous 20 years. However, the numbers of eels caught by the quantitative investigations are so small that estimates of yearly fluctuations based on them are not very reliable.

2. Isefjord-Roskildefjord.

In August 1948 and 1949 the following numbers of eels were caught per 1 hour with the eel-seine (numbers of stations in brackets):

	1948	1949	% males
Isefjord, outer broad ...	8 (9)	8 (3)	50
— — — ...	20 (3)	23 (5)	63
Lammefjord.....	32 (2)	24 (3)	67
Roskildefjord.....	44 (8)	34 (5)	96

The eel-seine is a better implement for catching eel than the eel-tog and these figures cannot be compared directly with those found for the Limfjord. Moreover, comparative fishing with the two implements have not yet been carried out to a sufficient extent to give a conversion factor. It is certain, however, that the stock is more dense than in the Limfjord.

The Lammefjord is a small fjord extending from the Isefjord outer broad. In this fjord seining is prohibited.

It is seen from the table that the percentage of males is very great in the Roskilde fjord. In the Limfjord most of the eels caught are females.

3. Prediction.

Prediction for the fishery of silver eels from the summer temperature of the water was given for the Limfjord and the Belt Sea. The mean temperature was about $\frac{1}{2}^{\circ}$ C. above the normal but rather low in August. A yield of ca. 5% above the normal was therefore foretold. In the Belt Sea the yield was actually 5% above the mean for the preceding 20 years but in the Limfjord it was the same as the mean for the 20 years. Here the yield has been rather low, especially since an intensive seine fishery for yellow eels has been carried on, and since that time the yearly fluctuations have shown little agreement with the temperature.

AAGE J. C. JENSEN.

Fish for Processing.

In 1949 the Danish fishery for fish-meal factories and fish pond food has been continued with about the same quantities being landed as in 1948.

As in previous years the majority was taken in the Skagerak and the northernmost Kattegat and landed at the harbours of Skagen, Frederikshavn and Hirtshals.

The catches in the various waters were:

North Sea.....	100 tons
Skagerak (Skagen excl.).....	3,490 —
Skagen (both Skagerak and Kattegat).....	28,620 —
Kattegat (Skagen excl.).....	6,950 —
Belt Sea.....	560 —
Limfjord.....	3 —
Total 1949.....	39.7 mill. kg.
1948.....	41.7 —
1947.....	23.8 —

During 1949 the investigations on the waste fish were extended and samples were examined, partly at the ports and partly in the laboratory. The figures below give the relative abundance by weight of the different species in the samples: —

	N. Kattegat and Skagerak	Belt Sea
No. of samples	141	117
	%	%
Whiting.....	49	53
Herring.....	15	22
Sprat.....	13	16
Other food-fishes.....	5 ¹⁾	6 ³⁾
Other fishes.....	19 ²⁾	2 ⁴⁾
Invertebrates.....	0.3	0.1

¹⁾ Haddock, hake, cod (0.4%), dab, mackerel.

²⁾ Norway pout, poor-cod, Couch's whiting, rockling, long rough dab, horse-mackerel.

³⁾ Mackerel, cod (0.96%), dab.

⁴⁾ Long rough dab, horse-mackerel.

There is no great difference between the northern area and the Belt Sea. In all Danish waters the fishing is mainly concerned with small whiting, small herring and sprat. Other food-fishes such as cod, haddock and dab are only caught in small quantities.

The stock of adult whiting is not likely to be seriously depleted by the fishery for the young, since the young are also to be found on many other grounds than those where this fishery is carried out. The same is true with the herring in the Skagerak, and partially so in the northern Kattegat; but in the southern areas, where young of local races are common, the fishing on the young can be of some danger to the main stocks.

In the northern Kattegat and the Skagerak the majority of the fish for processing are taken by a special fishery in which trawls are used with cod-end mesh sizes of 9–12 mm. from knot-to-knot. The remainder of the fish landed for processing are by-products of the trawl fishery for herring, sprat and deep sea prawn, and the pound net and other fisheries. In the Belt Sea the majority are by-products of the trawl fishery for herring and sprat. In addition to the young of the species mentioned above, a considerable amount of waste fish consists of large herring and mackerel which cannot be sold for human consumption.

J. B. KIRKEGAARD.

Rearing Experiments.

269.5 million cod fry from the hatchery were liberated in the fjords.

The rearing experiments of plaice larvae were also very successful this year. The mortality up to the stage of metamorphosis was not more than a few per cent.

Experiments on cod and herring larvae were also very successful.

Approximately 28,000 lobster larvae were reared to the bottom stage and liberated.

ALF DANNEVIG.

Shellfish.

Oyster.

The oyster thrived in the natural ponds. Some spawning took place, and a spatfall resulted.

Lobster.

The statistics of 25 fishermen proved that the fishing this year was very successful along the Skagerak coast, giving an average of 7.9 lobster per trap.

ALF DANNEVIG.

Deep Sea Prawn.

In July experimental fishing was carried out in the Skagerak with the commercial prawn-trawl. Two mesh-sizes, 18 mm. and 22 mm. from knot to knot, were used, and both Norwegian and Danish closing methods were used. The prawns caught were measured from the eye to the hind point of the telson. For the various hauls (hauls made in the summer of 1948 are also included) the following mean sizes in cm. (eye—telson) were found:—

Closing Method	18 mm. meshes					22 mm. meshes				
Norwegian.....	7.7	7.7	7.9	7.8	8.2	9.0				
Danish.....	8.2	7.6	8.0			8.1	9.4	9.3	8.5	

These figures do not indicate that the Norwegian closing method yields a catch of bigger prawns than the Danish closing method. The figures, however, show that the 22 mm. meshes yield far bigger prawns than the 18 mm. meshes. On account of this the percentage of females is higher with the 22 mm. meshes than with the 18 mm. meshes, viz., 49% against 31% (7 samples—1454 ind.).

From the measurements given above it is, however, clear that the mean size of the prawns caught varies considerably from one haul to another, and the investigations will be continued to get more reliable data.

Norwegian Lobster. During the experimental fishery with the eel-tog in the eastern Skagerak and the northern Kattegat a number of Norwegian lobsters were caught. The mean size of the males (105 spec.) was 14.1 cm., which is somewhat less than in 1948 (15.2 cm.—41 ind.) and in the years 1935/39 (15.2 cm.—420 ind.). This cannot, however, be taken as a proof of overfishing as it may be the result of a new year-class entering the catches.

ERIK M. POULSEN.

Baltic Area.

INTRODUCTION.

Contributions to this report have been received from Dr. AAGE J. C. JENSEN, Copenhagen, Dr. HARALD ALANDER, Gothenburg, and Dr. ARVID MOLANDER, Lysekil.

Environment.

Both Danish and Swedish investigations show that the inflow of water into the southern Baltic has been weak during the spring and summer of 1949, resulting in a decrease of the oxygen content in the deepest parts of that area.

ALANDER has ascribed the remarkably high salinity in the bottom layer (12.96‰) of the central Baltic east of Gotland to an influx of water into this area from the southern Baltic. In the Sea of Åland and in the Gulf of Bothnia the hydrographic conditions seem to have been normal. The high salinity (8‰) of the bottom layer of the Sea of Åland which was observed in 1948 has now decreased.

Danish investigations have been carried out with the aim of ascertaining if the dumping of poison gas after the end of the war at a place east of Bornholm had caused any harm to the animal life. The investigations indicate that the poison gas had probably not changed the normal hydrographical conditions at this place.

JENSEN gives a survey of his observations on the fat content of the plankton in 1949.

Fish Species.

Danish fishing experiments with ring-trawl at Møen, south of Scania, and at Bornholm in the spring (April–May) and in the autumn

(October), gave only very small catches of larvae of plaice, cod and herring.

A survey is given by JENSEN of fishing experiments with eel-tog for young cod carried out in the same areas as the experiments with the ring-trawl.

JENSEN and MOLANDER have made the usual investigations on the abundance of the young bottom stages of plaice, flounder and turbot. The investigations show the remarkable fact that the number of 0-group plaice was very much below the normal in the more westerly parts of the area, while this age-group was comparatively numerous on the south-eastern coast of Scania, the southern coast of Blekinge and at Bornholm.

Danish fishing experiments with eel-tog at Møen, south of Scania, and at Bornholm gave only very few plaice and dab. The experiments show that the stock of flat fish in the southern Baltic is still very thin. Some trawling experiments carried out in 1948 and 1949 by MOLANDER in the Bornholm area indicate the same fact. It is remarkable how few undersized plaice and flounder were caught by these experiments. MOLANDER also states that the growth rate of these species was very good in this area.

ALANDER gives a survey of the Swedish investigations on cod in different areas of the Baltic. The investigations show that the stock of cod everywhere in the Baltic is still very strong. As usual the average size of the cod was much greater in the Gulf of Bothnia than in the central and southern Baltic.

CHR. HESSLE.

ENVIRONMENT.

Hydrography.

Danish Observations.

Table 1. Monthly Means of Temperature and Salinity at Christiansø, N. of Bornholm.

(From the Danish Meteorological Institute, Nautical Department).

		1948						1949				
	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX
Temp.	11.7	8.3	6.4	4.5	3.6	3.0	3.9	8.1	11.8	16.9	15.9	17.4
Sal. ‰	7.7	8.1	8.1	8.2	8.3	8.4	8.4	8.3	8.0	8.0	7.8	7.9

HELGE THOMSEN.

The relatively high salinity of the upper layer is a consequence of the strong mixing of the water caused by the very stormy weather of the summer 1949. The mean salinity at Christiansø (1898–1930) varied between 7.0 in Sept.—May and 7.4‰ in July.

From ALANDER's observations in 1948 (Ann. Biol. V, p. 133) it is seen that an inflow had taken place before Dec. 1948, raising the oxygen content at Bornholm in 90–100 m. depth to ca. 4 ccm. from ca. 0.3 ccm. in Sept. (Ann. Biol. V, p. 131), and also raising the salinity and the temperature to ca. 17.1 promille and 10.0°C., respectively. The hydrographic data at Christiansø c. 1. May and 1. Sept. 1949 are given in Table 2. On the firstnamed date the oxygen content had fallen to c. 1.4 ccm. and on the lastnamed date to 0.26. Water with 18.3 promille and 4.2° was found 4. May 1949 W. of Bornholm at 55°07' N. Lat. and 14°20' E. Long. in 44½ m. depth originating from a minor winter inflow, but no significant inflow took place and the temperature of the bottom water was still high about 1. September.

In the autumn the intermediate cold layer was more pronounced than in 1948 although the winter of 1948/49 was warmer than that of 1947/48.

Poison gas. A special aim of the May investigation was to ascertain if the dropping of poison gas by the Russians east of Bornholm had caused any harm to the animal life. There had been a case of poisonous cod roe from a cutter which had caught one of the containers of poison, undoubtedly as a result of contamination by the fluid of the cod roe standing in a box on the deck.

Many samples of water taken near the bottom, and bottom samples from the place where

the poison had been dropped were investigated by the Ministry of Fishery Technological Laboratory and the roe of cod caught from "Biologen" at these places were also investigated. In none of these samples were traces of poison gas found though it must be remembered that the gases are destroyed very rapidly when they come in contact with water.

It might be suspected that their reduction was a contributory cause of the decreased oxygen content of the water. That was not the case as seen from two facts: Firstly an even greater rate of decrease in oxygen content was found by GEHRKE¹⁾ in 1906, when the oxygen content was reduced from c. 4 ccm. in February to c. 1 ccm. in May, i.e. during 3 months at a similar high water temperature, c. 5.2°C. (while in 1903 and 1904 the decreases were somewhat slower at the lower temperature of

¹⁾ I. GEHRKE: Beiträge zur Hydrographie des Ostseebassins. Publications de Circonstance, Nr. 52. 1910.

Table 2. Hydrography at Christiansø.

	30.4. 1949			28.8. 1949		
	55°27' N. Lat.			5°18.5' N. Lat.		
	15°10' E. Long. ¹⁾			15°13.6' E. Long. ²⁾		
	t°	S ‰	O ₂ ccm.	t°	S ‰	O ₂ ccm.
2	5.2	8.2	—	16.8	8.1	—
30	3.9	8.3	—	—	—	—
35	—	—	—	7.4	8.0	—
40	4.0	8.5	—	—	—	—
50	3.2	9.9	—	4.7	8.8	—
60	3.2	13.6	5.69	6.4	11.3	4.15
70	4.9	15.6	5.11	6.3	14.7	2.12
75	8.1	16.7	1.83	—	—	—
80	—	—	—	7.7	16.7	0.53
85	8.6	17.0	1.39	7.7	16.9	0.26
92	8.3	17.2	1.43	—	—	—

¹⁾ 85 and 92 m. at 55°24' N. Lat. 15°20' E. Long.

²⁾ 60 and 85 m. at 55°22.5' N. Lat. 15°11.2' E. Long.

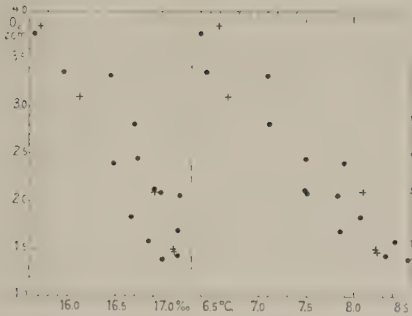


Figure 1. Correlation between oxygen contents and salinity and temperature, respectively.
+ where poison gas was thrown out, • at other places.

the water, c. 3.5°). Secondly the oxygen contents were very nearly the same at the places where the poison gas was thrown out as at other places to the east of Bornholm, as appears from Fig. 1. From this figure it is seen that the oxygen content is linearly correlated with the salinity and temperature of the water, and that the oxygen content at the places where the poison gas was thrown out do not differ from the "normal" according to the salinity and temperature of the water.

AAGE J. C. JENSEN.

Swedish Observations.

During the winter of 1948—1949 there seems to have been rather small changes in the hydrographic conditions in the southern Baltic. In May 1949 the upper layers were of about the normal temperature. The warming-up of the water had just started and had not penetrated to deeper than about 10 m. (see Fig. 2). Be-

tween 20 and 40 m. the temperature was very uniform and at 50 m. there was a minimum of 3.28°C. The deeper layers were fairly warm, with a temperature of 8.01° at 100 m. The temperature has now been remarkably high in the deeper parts of the southern Baltic for some years in succession. From the surface down to 40 m. the changes in the salinity were small, indicating a thorough mixing of the water. At greater depths the salinity increased rapidly and attained the remarkably high value of 16.94‰ at 100 m. The water between 80 and 100 m. seemed to be fairly homogeneous and very little disturbed, which is indicated by the rather low oxygen content of the bottom water.

In the central Baltic three hydrographic observations were made in a very short space of time between Öland and Gotland, east of Gotland, and in the Landsort Deep. The hydrographic conditions at the three stations were very uniform, when the values from the surface to about 80 m. are considered (see Figs 3, 4 and 5). Especially marked is the conformity between the two stations in the area west of

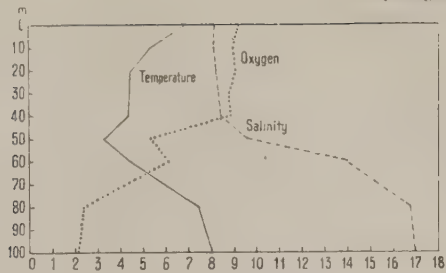


Figure 2. Christianso 2/5 1949.

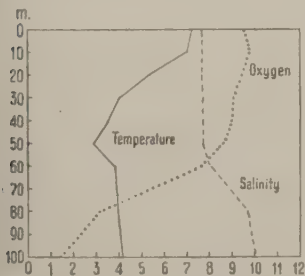


Figure 3. Between Öland and Gotland 21/5 1949.

Figure 4. East of Gotland 18/5 1949.

Figure 5. Landsort Deep 21/5 1949.

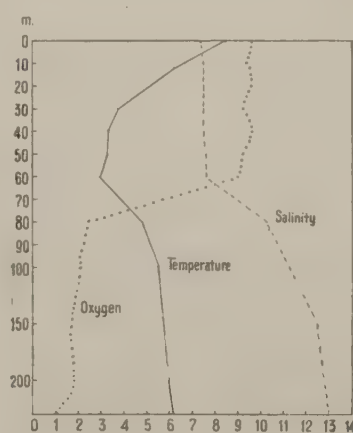


Figure 4.

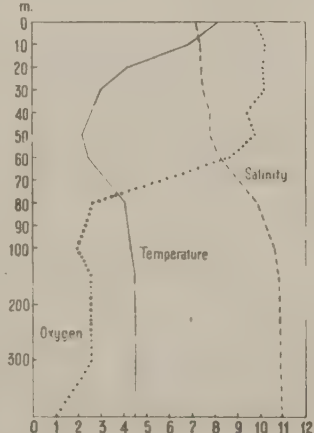


Figure 5.

Gotland. In this area there seems to have been only very small changes in the hydrographic conditions since 1948. The temperature-curve runs rather evenly with a not very pronounced minimum at 50 m. At greater depths the curve is almost a straight line. East of Gotland there was a slight but distinct increase in the temperature at greater depths and at 228 m. 6.10° were recorded. This temperature is rather high and is probably due to the influx of warm bottom water from the Bornholm Basin to the eastern parts of the central Baltic. In the western parts of this area the influence of this water seems to have been very small. The salinity in the upper strata was fairly high, as in previous years, and there was no distinct boundary between the surface layer and the bottom layer with its higher salinity. East of

Gotland the salinity was considerably higher in the bottom layer than in the Landsort Deep. The salinity of 12.96‰ in this layer east of Gotland is remarkably high and was no doubt a result of the increased salinity in the southern Baltic.

As to the hydrography of the Gulf of Bothnia, it is worth mentioning that there has been close cooperation between the Finnish and Swedish scientists in that area in 1949. The observations, however, are still in course of preparation. But on the whole, only fairly small changes in the hydrographic conditions seem to have occurred in the winter of 1948–1949 in this area. In the Sea of Åland the high salinity in the bottom water which was observed in the autumn 1948 had now, however, decreased to more normal values.

HARALD ALANDER.

Plankton.

At Bornholm and S. of Scania.

The fat content of the plankton was investigated 5. May at 10 stations. It varied between 28.4 and 36.5% and the mean was 32.9%. No data for comparison with former years are at hand but the values may seem to be very high. The 24.–29. August the fat content was investigated at 18 stations. It varied very much, between 2.8 and 27.8%, at the various stations

and there does not seem to be any trend in the variations either according to the various sections of the area or to the depth at the stations. Neither can any correlation with the hydrography be found. The mean of 16 determinations from around Bornholm was 13.7%, which is lower than the average for the 8 previous years, viz: 18.4%.

AAGE J. C. JENSEN.

THE FISH.

Fish Larvae.

Fishing with ring-trawl 27.4.49–5.5.49 at 7 stations in the Møen area, S. of Scania and round Bornholm gave a mean of only 1.1 plaice larvae and 1.4 cod larvae per hour, and no herring larvae were found. Three hauls with ring-trawl in the Møen area 19.10.49 gave a mean per hour of 5 herring larvae of 6–12 mm. length.

Cod.

Danish Investigations.

Fishing experiments with the eel-tog (see Table 3) showed more of the older cod (IV- and V-groups) than in the Transition Area and about the same density of the I- and II-groups as in the Belts, the Western Baltic and the Sound. The number of stations is too small for an assessment of the density of the 0-group.

Table 3. Number of Cod caught per 1 Hour in Eel-tog from S/S "Biologen".

	Date	No. of station	Depth, m.	Age-groups						
				0	I	II	III	IV	V	VI
At Møen	19—20/8	2	18—29	5	1	5	—	—	—	—
S. of Scania and at Bornholm	30/8—3/9	7	46—94	1	3	3	1	6	6	1
	21—28/8	9	36—96	11	9	3	1	1	0.2	—

AAGE J. C. JENSEN.

Swedish Investigations.

In the southern Baltic the stock of cod was very strong in 1949 and the yield from the fishery was consequently very large. Trawl catches were predominating, but the long-line fishery also gave very large catches, which indicates that the increase in catches was due not only to improved fishing methods but also to an increased stock of cod. From the investigations carried out in May 1949 a rather good picture of the composition of the stock of cod in this area was obtained. Fig. 6 shows the length distribution of the cod in a number of representative catches made with sprat-trawl and ordinary fish trawl in the southern Baltic. The large number of small cod in the catches clearly shows that recruitment to the stock has been very good in the previous years.

The stock of cod was also very large in the central Baltic. As the bottom conditions in that area are mostly unsuitable for trawling, only catches with long-line were obtained, and they are of course not so representative of the composition of the stock as the trawl catches. Fig. 7 shows the length distribution of a catch from the east coast of Gotland. The chief part of the catch consists no doubt of cod of the rich year-classes spawned during the early years of the 1940ties.

In the Sea of Bothnia the stock of cod is of course not so rich as in the southern and central Baltic, but there seems to have been a

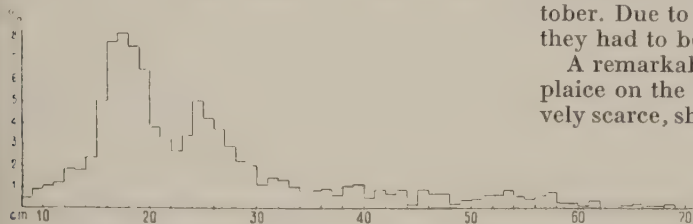


Figure 6. Cod (trawl catches), southern Baltic, May 1949.

fairly strong increase of the stock in recent years. As a rule the cod is found at considerable depths in the Sea of Bothnia. The best catches are generally made at greater depths than 100 m. In August 1949, however, some long-line catches were obtained in rather shallow water, 10–40 m., off Umeå in the northernmost part of the Sea of Bothnia. The length-distribution of the cod in the catches from the Sea of Bothnia is shown in Fig. 8. As usual in this area large cod forms the chief part of the catches.

HARALD ALANDER.

Flat Fishes.

0- and I-groups.

Danish Coasts.

The number of 0-group of plaice, flounder and turbot caught per 1 hour (in previous years per 30 minutes) are given in Table 4, the 0-group plaice also on Fig. 1, p. 147. It is seen that the number of plaice was very small at Sjælland-Møen but above the normal at Bornholm, and the number of flounder at Sjælland-Møen very much below the normal and at Bornholm half of the normal, but the number of turbot above the normal. Of I-group plaice a mean of 1 was found at Sjælland-Møen, none at Bornholm, 0.3 I-group turbot was found per hour at Bornholm.

Table 4. Abundance of 0-group of Plaice, Flounder and Turbot at the Baltic Area Coasts of Denmark.

Number caught per 1 hour with Johansen young-plaice trawl at Sjælland-Møen and with the hand push-net at Bornholm. In brackets means for 1928–49.

	No. of stat.	Plaice	Flounder	Turbot
Sjælland-Møen	6	2 (5)	24 (394)	0 (0.6)
Bornholm	13	25 (16)	107 (231)	62 (25)

A. J. C. JENSEN.

Swedish Coasts.

The investigations took place on the south coast and were carried out at the end of October. Due to a long period of stormy weather they had to be delayed.

A remarkable fact is that while the 0-group plaice on the south coast of Scania was relatively scarce, showing figures considerably lower

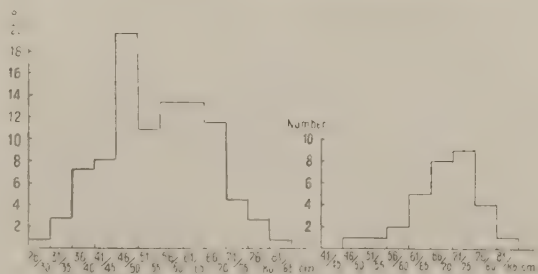


Figure 7. East coast of Gotland.

Figure 8. Sea of Bothnia, August 1949.

Cod (long-line catches).

than both in 1948 and the mean for 1929–38, the situation was quite the reverse on the east coast of Scania and in Blekinge. Seldom have so many 0-group plaice been found in the skerries of Blekinge. The failure of the fishery on the south coast of Scania may possibly have been influenced by the comparatively bad weather.

Except at Blekinge, the abundance of 0-group flounder was about the same as in 1948. This was specially the case on the south coast, where the catches were even below the average for recent years. The good catches of the I-group in Blekinge must be mentioned; the I and even the II-group occurred there in the shallowest water in greater numbers than anywhere on the coast (cp. the mean for 1929–38).

The 0-group turbot was present to a normal extent on the east coast of Scania and in Blekinge, and was more numerous than in 1948. The bad catches of 0-group turbot on the south coast, just as those of plaice on the south coast of Scania, have possibly been due to the bad weather during the investigations.

Table 5. 0- and I-group Plaice, Flounder and Turbot taken per $\frac{1}{2}$ hour at $\frac{1}{2}$ –3 m. Depth.

Year	Southern Scania 10		Eastern Scania 11		Blekinge 3	
	0-gr.	I-gr.	0-gr.	I-gr.	0-gr.	I-gr.
Plaice						
1948.....	15	1	10	0	0	0
1949.....	6.3	3.8	21.2	0	5.7	5.0
Mean.....	37	7	2	6	0.2	0.3
Flounder						
1948.....	93	21	175	39	43	128
1949.....	4.7	2.9	66	6.8	50	159
Mean.....	101	50	36	17	153	119
Turbot						
1948.....	0	0.3	0	0	0	0
1949.....	0.7	0.2	6.5	0	5.0	0
Mean.....	4	1.1	3	0.5	5	0.6

A. R. MOLANDER.

Older Age-Groups.

Danish Investigations.

Fishing experiments with the eel-tog at Bornholm in May and in the Møen area, south of Scania and at Bornholm in August 1949 at 18 stations (9 hours fishing) gave only 4 plaice of which 2 were IV-group, 1 of the V-group and 1 unknown. In addition, 5 dab were caught of which 3 were II-group, 1 was III-group and 1 VI-group. One long rough dab of the II-group was caught. It is seen that the stock of flat fishes is very sparse.

AAGE J. C. JENSEN.

Swedish Investigations.

Tables 6 and 7 show that there was a strong length increase in plaice both in 1948 and 1949. In 1948 the fish were chiefly spent and the 4-year-olds dominated. In 1949 a great many plaice, mostly males, were still running; the 4-year-olds predominated.

In the case of the flounder there was a strong increase in length in 1948 and in 1949 the growth showed a good increase. In 1948 spawning had not yet started, the females being in a slightly more advanced stage of maturity than the males. In 1949 the majority of flounders, chiefly females, were spawning.

Plaice and Flounder from the Southern Baltic in 1948 and 1949.

Date 1948: 17/3–23/3. 1949: 4/4–11/4

Hours trawling 1948: 6 h. 15 min. Seven hauls.
“ “ 1949: 7 h. 35 min. Eight hauls.

Stations 1948		Stations 1949	
Lat. N.	Long. E.	Lat. N.	Long. E.
55°17.5'	14°35'	55°18'	15°00'
55°18'	15°00'	55°31.5'	14°49'
55°31.5'	14°49'	55°24'	15°22'
55°30.5'	14°42'	55°31.5'	15°44'
55°09'	15°23.5'	55°28'	15°09'
55°30'	15°15'	55°02'	14°00'
		55°00'	13°49'
		55°01.5'	13°30'

Table 6. Maturity Stages

1948.

Age Stage	Plaice						Flounder					
	3	4	5	6	7		3	4	5	6	7	
I	1	—	—	—	—	—	—	—	—	—	—	—
II	9	5	4	1	—	—	1	—	—	—	—	—
IV	—	1	—	—	—	—	2	—	4	1	5	1
V	—	1	—	1	—	—	2	2	3	3	1	1
VI	1	1	4	—	—	—	—	2	2	1	2	—
VII	3	1	9	22	2	3	1	1	—	1	—	—
Total	14	2	17	30	4	4	1	5	4	10	5	8

1949.

Age Stage	Plaice					Flounder				
	3	4	5	2	3	4	5	6	7	8
I	7	1	—	—	—	—	—	—	—	—
II	—	—	—	—	—	—	—	—	—	—
III	—	—	—	—	—	—	—	—	—	—
IV	1	—	—	—	—	15	—	2	—	—
V	—	—	—	—	—	12	3	2	—	—
VI	10	—	16	1	—	19	12	4	19	2
VII	3	4	7	10	2	10	7	10	8	1
Total	21	5	25	11	2	65	23	18	27	3

Table 7. Length Distribution.

1948.

Age: cm.	Plaice							Total	Flounder							Total
	3		4		5		6		3		4		5		6	
	♂	♀	♂	♀	♂	♀	♀		♂	♀	♂	♀	♂	♀	♀	
20	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	3
21	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
23	—	—	—	—	—	—	—	—	—	1	—	1	1	—	—	4
24	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	1
25	2	—	—	—	—	—	—	2	1	1	—	—	—	—	—	1
26	1	—	—	—	—	—	—	1	—	—	1	—	—	—	—	1
27	1	—	—	—	—	—	—	1	—	1	—	1	—	—	—	2
28	1	—	—	—	—	—	—	1	—	—	1	1	—	—	—	2
29	6	—	—	—	—	—	—	6	—	1	—	—	1	—	—	2
30	1	1	—	1	1	—	—	4	—	—	—	2	—	—	—	2
31	2	—	2	1	—	—	—	5	—	—	—	2	—	1	—	3
32	—	—	—	1	—	—	—	1	—	—	—	—	1	1	—	2
33	—	1	2	1	—	—	—	4	—	—	—	2	2	—	—	4
34	—	—	3	3	1	—	—	7	—	—	—	—	—	1	—	1
35	—	—	6	2	1	—	—	9	—	—	—	1	—	—	—	1
36	—	—	3	3	—	1	—	7	—	—	—	—	—	1	—	1
37	—	—	—	7	—	1	—	8	—	—	—	—	—	1	—	1
38	—	—	1	7	1	1	—	10	—	—	—	—	—	1	1	2
39	—	—	—	2	—	—	—	2	—	—	—	—	—	—	—	—
40	—	—	—	2	—	—	—	2	—	—	—	—	—	2	—	2
41	—	—	—	—	—	1	—	1	—	—	—	—	—	—	1	2
45	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—
52	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—
Mean	28.3	31.5	34.4	36.3	34.4	38.0	(45.0)	(52.0)	20.8	26.6	26.0	30.2	30.0	36.0	(39.5)	(41.0)

1949.

Age: cm.	Plaice							2	Flounder							5
	3		4		5				3		4		5			
	♂	♀	♂	♀	♂	♀		♂	♂	♀	♂	♀	♂	♀		♀
18	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—	4	1	—	—	—	—	—	—
21	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—
22	—	—	—	—	—	—	—	—	5	1	—	—	—	—	—	—
23	—	—	—	—	—	—	—	—	12	2	—	—	—	—	—	—
24	—	—	—	—	—	—	—	—	13	—	—	—	—	—	—	—
25	1	—	—	—	—	—	—	—	11	4	—	—	—	—	—	—
26	2	—	—	—	—	—	—	—	5	4	1	1	—	—	—	—
27	1	—	—	—	—	—	—	—	6	4	1	1	—	—	—	—
28	5	—	—	—	—	—	—	—	1	2	3	3	—	—	—	—
29	6	—	—	—	—	—	—	—	1	3	2	6	—	—	—	—
30	2	—	—	—	—	—	—	—	—	—	5	4	—	—	—	—
31	2	2	—	—	—	—	—	—	—	—	1	4	—	1	—	—
32	2	1	2	—	—	—	—	—	—	1	—	—	—	—	—	—
33	—	1	3	—	—	—	—	—	—	1	—	2	—	—	1	—
34	—	1	4	—	—	—	—	—	—	—	1	1	—	—	1	—
35	—	—	5	2	1	—	—	—	—	—	1	1	1	1	—	—
36	—	—	7	1	—	—	—	—	—	—	3	1	2	—	—	—
37	—	—	3	1	—	—	—	—	—	—	—	1	—	—	—	—
38	—	—	1	—	—	1	—	—	—	—	—	2	—	—	—	—
39	—	—	—	4	1	2	—	—	—	—	—	—	—	—	6	—
40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41	—	—	—	1	—	3	—	—	—	—	—	—	—	—	—	—
42	—	—	—	2	—	1	—	—	—	—	—	—	—	—	2	—
43	—	—	—	—	—	3	—	—	—	—	—	—	—	—	4	—
Mean	28.7	32.2	35.0	38.5	37.0	41.0	(18.0)	23.7	26.4	30.7	31.1	35.7	38.9			

ARVID R. MOLANDER.

Herring.

INTRODUCTION

The following contributors have submitted reports dealing with general herring problems—stock changes, and inter-relationship between stocks etc.

The fishery in Irish Waters was a failure during 1949 and in consequence it was impossible to publish a scientific report for that area.

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|----------------------------------|---------|-----------------------------------|----------|
| 1. M. C. GILIS | Belgium | 5. Mr. ARNI FRIDRIKSSON | Iceland |
| 2. Dr. A. J. C. JENSEN | Denmark | 6. Mr. F. DEVOLD | Norway |
| Mr. J. B. KIRKEGAARD | » | 7. Dr. H. WOOD | Scotland |
| Dr. A. V. TÄNING | » | Mr. G. McPHERSON | » |
| 3. Dr. W. C. HODGSON | England | Mr. A. SAVILLE | » |
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W. C. HODGSON.

REPORTS

A. Iceland—Norwegian Sea.

1. YOUNG STAGES

Larvae in Norwegian Waters see North-Eastern Area report, p. 15.

2. COMMERCIAL FISH

On the Herring of the North Coast of Iceland during the Summer of 1949.

In the following tables some records are given on the stock of herring caught off the north coast of Iceland in 1949. The total

number investigated in our laboratory in Siglufjord, which is situated on the middle of the north coast, amounted to 3683 herrings. In Siglufjord, we got preferably material from the western (V), middle (M) and the eastern part of the N.-coast (E_1), but a great deal of the herring caught in this last-named area, and most of the herring caught east and south of Langanes (E_2) is normally landed for factories farther east (see Fig. 1).

Table 1 gives a survey of the size-distribution of the herring during the season (July-



Map to show the Sub-Division of the North-Coast Herring Fishing Grounds.

September). The herring is somewhat larger than usual, being 35.22 cm. on an average or about 0.30 cm. over the normal. This is thought to be due to the failure of the main stock to enter the proper fishing grounds the consequence of which will be a relative predominance of older, and more stationary fish. The bulk of the yield was taken in the east (E_1 and E_2) and the main stock has probably been situated still further east. As in the general rule, we find the size decreases from west to east also this year.

3465 herrings were examined for age, and the result is shown in Table 2, where the brood-years and the year-classes are noted, and the size-distribution and the average size for each year-class is given. The age ranges from 2 to 22 years, comprising 21 year-classes, 1927—1947 included. There are four dominating year-classes which are 12, 14, 15 and 16 years old (born in 1937, 1935, 1934 and 1933). They make up 54.7% of the total catch or nearly 14% each on an average. The strongest

one is the brood from 1937, (12-year-old herring) contributing 17.7%, closely followed by 15-year-old herring (born in 1934), which comprises 16.5%. There is now only little left of the two formerly great dominant broods of 1930 and 1932 (now 19 and 17 years old). They only contribute 1.1 and 3.7% respectively. The average age of all herring examined this year turned out to be 12.3 years or 0.8 years over the average age for the period 1937—1942, this relatively high age being in good agreement with the relatively large size.

The scale material collected through the summer season in 1949 was investigated for the purpose of finding out the relative strength of the different tribes of the herring present, as well as their morphological features. A glance at Table 3 will give a general survey. Out of 3683 herrings examined in this way, we find 3134 fish belonging to the Atlanto-Scandian type (Norwegian "large" and "spring" herring), only 174 herrings of Icelandic origin (mostly spring spawners) and 375 herrings whose origin cannot be determined.

Thus, the Norwegian herring makes up at least 85.1% of the stock, whereas Icelandic herring is contributing by 4.7%, and 10.2% are uncertain. Summer spawning herrings were hardly seen off the N. coast this summer. If we ignore the uncertain 375 herrings, the stock was composed of:

1) 73.9% (2442) Atl.-Scand. herring of the northern type.

Table 1. The Length of the North-Coast Herring in 1949 according to Areas.

cm.	V	M	Number E_1	E_2	Total	V	M	% E_1	E_2	t To al
40	2	—	—	—	2	2	—	—	—	1
39	6	1	1	—	8	7	1	1	—	12
38	36	10	22	—	68	40	13	13	—	18
37	186	70	146	4	406	207	88	86	14	100
36	344	225	493	58	1120	382	281	290	205	334
35	233	285	610	120	1248	259	356	358	423	349
34	51	139	290	65	545	57	174	171	230	138
33	14	38	63	16	131	16	48	37	57	26
32	10	21	57	9	97	11	26	34	32	16
31	13	7	14	8	42	14	9	8	28	2
30	3	2	2	3	10	3	2	1	11	3
29	2	—	2	—	4	2	—	1	—	1
28	—	—	—	—	—	—	—	—	—	—
27	—	1	—	—	1	—	1	—	—	+
24	—	1	—	—	1	—	1	—	—	+
Total:.....	900	800	1700	283	3683	1000	1000	1000	1000	1000
%.....	245	218	460	77	1000	—	—	—	—	—
cm.....	35.74	35.08	35.11	34.63	35.22	—	—	—	—	—

Table 2. Age-Size Composition of the North-Coast Herring in 1949.

Brood:	1947	1946	1945	1944	1943	1942	1941	1940
Age:	2	3	4	5	6	7	8	9
cm.								
37	—	—	—	—	—	—	1	5
36	—	—	—	—	1	5	11	40
35	—	—	—	1	11	28	53	119
34	—	—	—	6	48	48	48	67
33	—	—	2	26	54	20	5	3
32	—	—	20	54	22	—	—	—
31	—	1	21	14	5	—	—	—
30	—	1	7	2	—	—	—	—
29	—	1	3	—	—	—	—	—
27	—	1	—	—	—	—	—	—
24	1	—	—	—	—	—	—	—
Total:	1	4	53	103	141	101	118	234
o/oo	+	1	15	30	41	29	34	68
cm.	24.00	28.25	31.21	32.22	33.29	34.18	34.58	34.90

Brood:	1939	1938	1937	1936	1935	1934	1933	1932
Age:	10	11	12	13	14	15	16	17
cm.								
40	—	—	—	—	—	—	1	—
39	—	—	—	—	—	3	1	1
38	1	1	2	—	5	15	13	9
37	5	9	45	27	49	103	71	24
36	38	69	204	68	149	219	142	54
35	74	114	259	60	140	191	91	34
34	34	61	95	11	28	39	21	4
33	2	4	5	1	1	1	—	1
Total:	154	258	610	167	372	571	340	127
o/oo	44	74	177	48	107	165	98	37
cm.	35.09	35.08	35.32	35.65	35.62	35.81	35.91	36.00

Brood:	1931	1930	1929	1928	1927	Total	o/oo
Age:	18	19	20	21	22		
cm.							
40	—	1	—	—	—	2	1
39	—	2	—	—	—	7	2
38	5	4	2	1	—	58	17
37	17	14	2	—	1	373	106
36	29	11	4	1	—	1045	302
35	8	6	2	—	—	1191	345
34	—	1	—	—	—	511	147
33	—	—	—	—	—	125	36
32	—	—	—	—	—	96	28
31	—	—	—	—	—	41	12
30	—	—	—	—	—	10	3
29	—	—	—	—	—	4	1
27	—	—	—	—	—	1	+
24	—	—	—	—	—	1	+
Total:	59	39	10	2	1	3465	—
o/oo	17	11	3	1	+	1000	—
cm.	36.32	36.62	36.40	37.00	37.00	35.20	—

2) 20.9% (692) Atl.-Scand. herring of the southern type.

3) 5.2% (174) local Icelandic herring.

It is worth noting that the northern type of the Norwegian herring is largely predominating, contributing by nearly three quarters of the catches, and that the endemic part of the

Table 3. The Tribes in the North-Coast Herring according to the Structure of the Scales.

	North-Norway Type	South-Norway Type	Total	Icel. Type	Uncertain
Brood-Years	Number	Number	Number	Number	Number
1947...	—	—	—	6	—
1946...	—	1	1	0	11
1945...	—	4	4	1	247
1944...	9	18	27	9	374
1943...	47	54	101	32	149
1942...	25	39	64	20	63
1941...	32	14	46	88	28
1940...	59	24	83	195	62
1939...	78	32	110	136	43
1938...	192	79	271	244	78
1937...	564	233	797	602	192
1936...	123	50	173	154	49
1935...	301	124	425	350	112
1934...	498	204	702	550	175
1933...	277	113	390	318	101
1932...	95	35	130	118	38
1931...	50	20	70	59	19
1930...	33	14	47	37	12
1929...	7	3	10	3	—
1928...	1	0	1	2	1
1927...	1	0	1	1	0
R.....	2	1	3	2	1
?.....	48	2	50	71	23
Total:..	2442	999	3441	3134	999
				1001	174
				375	—

stock is nearly insignificant. The age-composition of the three components of the stock is also of great interest. We see that all the four above-mentioned dominating year-classes are mainly due to the northern part of the Atl.-Scand. stock, constituting about two-thirds of this, the 1937 brood (12-year-olds) being the strongest (23.3%). In the southern type of herring we have a dominant but, owing to the relative scarcity of this part of the stock, it hardly appears in the catch as a whole. This is the 1940-brood (9-year-olds), amounting to 19.4% in this portion of the stock.

Special attention should be paid to the age-composition of the local herring (Icelandic type) which consists mainly of three year-classes, 4, 5 and 6-year-olds originating from the years 1943, 1944 and 1945. The 1944-brood (5-year-olds) is strongest, amounting to 37.4% of this tribe. All three year-classes make out 77% of the local stock.

Table 4 gives a survey of the length-distribution in the different stocks, which is in good agreement with the age-composition. We find the largest herring in the northern part of the Atl.-Scand. stock, where the lengths are mainly ranging between 34 and 37 cm. (incl.) being

Table 4. Size Composition of the Tribes in the North-Coast Herring in 1949.

Cm.	Atlantic-Scandinavian			Icel. Herring	Atl.-Sc. %	Icel. %
	Northern	Southern	Total			
40	2	—	2	—	1	—
39	6	1	7	—	2	—
38	41	12	53	—	17	—
37	310	56	366	2	117	11
36	827	194	1021	7	326	40
35	888	230	1118	15	356	86
34	303	142	445	21	142	121
33	41	41	82	31	26	178
32	16	12	28	58	9	334
31	7	4	11	28	4	161
30	1	—	1	8	0	46
29	—	—	—	2	—	11
27	—	—	—	1	—	6
24	—	—	—	1	—	6
Total:	2442	692	3134	174	1000	1000
Av. l.	35.47	35.10	35.39	32.54	—	—

35.47 cm. on an average. The herring belonging to the southern type is considerably smaller, mainly ranging between 34—36, with an average length of 35.10. Taken as a whole only 2.0% of the Atl.-Scand. herring exceed 37 cm. and 3.9% are below 34. The greatest part, or 94.1%, is 34—37 cm. with an average length of 35.39 cm. As could be expected when the age is considered, the Icelandic herring is much smaller, only 32.54 cm. on an average and mostly ranging from 31—34 cm. (incl.), as these four size-classes make out nearly 80% of the total.

In Table 5 comparison is made as to the Atl.-Scand. herring on one side and the Icelandic one on the other side, with regard to growth-rate according to scale-measurements and the number of vertebrae for corresponding year-classes. This comparison is rather difficult as the number of Icelandic herrings is too small to allow any general conclusions. As far as the material can possibly be compared (the year-broods 1941—1945) we find no positive correlation between the number of vertebrae in the Atl.-Scand. herring and in the corresponding year-broods in the Icelandic stock. The average number of vertebrae in the broods is as follows:

Average Number of Vertebrae

brood year	in Norway	in Iceland
1941	high	low
1942	high	low
1943	high	high
1944	high	high
1945	(low)	high

Table 5. Age, Size and Number of Vertebrae in the Tribes of the North-Coast Herring in 1949.

Brood-Years	Age (Years)	Atlantic-Scandinavian			Icelandic Herring		
		Length cm.	VS	Number	Length cm.	VS	Number
1947...	2	—	—	—	24.00	58.00	1
1946...	3	31.00	58.00	1	28.50	57.00	2
1945...	4	31.25	57.00	4	31.18	57.33	43
1944...	5	32.30	57.44	27	32.16	57.31	67
1943...	6	33.30	57.26	101	33.20	57.24	25
1942...	7	34.27	57.23	64	34.00	56.00	10
1941...	8	34.65	57.16	88	34.55	57.00	11
1940...	9	34.92	57.41	195	34.75	57.50	4
1939...	10	35.10	57.33	136	35.20	57.80	5
1938...	11	35.08	57.08	244	36.00	57.00	1
1937...	12	35.31	57.23	602	36.00	57.00	1
1936...	13	35.64	57.16	154	37.00	57.00	1
1935...	14	35.63	57.19	350	—	—	—
1934...	15	35.74	57.21	550	37.00	57.00	1
1933...	16	35.93	57.07	318	36.00	58.00	1
1932...	17	35.95	57.14	118	—	—	—
1931...	18	36.49	57.14	59	—	—	—
1930...	19	36.65	57.08	37	—	—	—
1929...	20	36.30	57.10	10	—	—	—
1928...	21	37.00	57.00	2	—	—	—
1927...	22	37.00	57.00	1	—	—	—
?.....	?	—	—	73	35.00	58.00	1
Total:..	—	—	57.20	3134	—	57.28	174

We arrive at quite similar results if we compare the number of vertebrae in the Icelandic herring with the figures given for the Norwegian herring in Table 6, where the vertebrae number is recorded separately for the southern and the northern types. By considering the average length of the different year-classes of Norwegian and Icelandic herring it looks as if the growth in Iceland has been slower than in Norway during recent years, and faster about ten years ago and earlier, but it must be kept in mind that this material is not suitable for any definite conclusion.

In Table 6 the average size and the average number of vertebrae has been calculated separately for every year-class of the northern and the southern type of the Atl.-Scand. stock. The table confirms, what is already well known from Norwegian herring investigations, that (a) the southern type maintains a higher growth-rate than the northern one, and (b) the number of vertebrae is, with few exceptions, higher in the southern type than in the northern one. But there is one more interesting feature that can be seen from the table: The trend is towards an increase in the number of vertebrae during recent years, in both types

of this stock. If we consider the year-classes 1927—1944 (incl.) which are represented in both types, we find the following average number of vertebrae for each period of six years:

	Northern Type	Southern Type
1927—1932.....	57.070	57.127
1933—1938.....	57.155	57.133
1939—1944.....	57.291	57.298

It is true that the material in the highest and lowest year-classes is too scanty for general conclusions, but the trend in both types is the same, towards an increasing number of vertebrae.

Table 7 gives a general idea of the number of vertebrae in all N.-coast herring in relation to the stages of maturity. During the season two stages of maturity are largely predominating, viz., III and VIII. The greatest part of the herring enters the fishing grounds when still at stage VIII or VIII—III and leaves when stage III or III—IV has been reached. The number of herring at III and VIII was found to be 3444 or 935⁰/₀₀ in 1949. Some of the herrings at stage VII (28 fish or 8⁰/₀₀) might be summer spawners as the number of vertebrae is low, but it is interesting to note, that the only certain summer spawner (St. VI) we find in the material has 58 vertebrae.

Table 6.
Atlantic-Seandian North-Coast Herring.

Average Length and Number of Vertebrae in Relation to Age.

Brood- Years	Age (Years)	Northern Type		Southern Type	
		Length cm.	VS	Length cm.	VS
1946...	3	—	—	31.00	58.00
1945...	4	—	—	31.25	57.00
1944...	5	31.56	57.44	9	32.67
1943...	6	32.89	57.30	47	33.61
1942...	7	34.28	57.36	25	34.26
1941...	8	34.67	57.18	32	34.62
1940...	9	34.76	57.17	59	35.00
1939...	10	34.99	57.30	78	35.24
1938...	11	35.05	57.07	192	35.17
1937...	12	35.30	57.24	564	35.34
1936...	13	35.62	57.15	123	35.71
1935...	14	35.70	57.19	301	35.71
1934...	15	35.74	57.22	498	35.98
1933...	16	35.92	57.06	277	36.07
1932...	17	35.97	57.12	95	35.91
1931...	18	36.26	57.04	50	36.78
1930...	19	36.79	57.12	33	35.50
1929...	20	36.14	57.14	7	36.67
1928...	21	38.00	57.00	1	36.00
1927...	22	37.00	57.00	1	—
?.....	?	35.46	57.28	50	—
Total:..	—	—	57.18	2442	—

As compared with material from the years 1938—1942 (17,673 individuals) of spring spawners, where VS was 57.048 the number of vertebrae has this year been relatively high or 57.171. There are now many more fish with 58 vertebrae and much less with 56 than previously, as may be seen from the following figures:

VS	1938—1942 %	1949 %	1949 — (1938-1942)
< 58	0.6	1.2	+0.6
58	19.4	26.5	+7.1
57	64.8	60.9	-3.9
56	14.7	10.9	-3.8
> 56	0.5	0.5	0.0
Total:	100.0	100.0	0.0

The average number of vertebrae of the Atl.-Scand. Herring (column 3 of Table 7) is higher than that of the whole stock, viz., 57.196, which might indicate that some of the Icelandic herrings present off the N. coast this year could be summer spawners.—We also

Table 7. Maturity Stages in Icelandic North-Coast Herring.

a) Rate of Maturity stages (‰)

Mat. stage	All	Atl.-Scand.		Icelandic N. coast herring
		Northern Type	Southern Type	
?	1	1	—	—
I	2	2	—	6
II	8	3	6	98
III	541	568	579	299
IV	44	46	47	34
V	3	5	—	46
VI	0.3 ¹⁾	—	—	6
VII ..	8	5	4	29
VIII..	394	377	366	483

b) Total number of vertebrae and of fish investigated

II....	57.14	57.1	57.5	56.8	57.2
n....	(28)	(8)	(4)	(4)	(17)
III....	57.20	57.22	57.22	57.26	57.39
n....	(19 91)	(17 79)	(14 14)	(365)	(52)
IV....	57.20	57.26	57.24	57.32	57.0
n....	(1 62)	(1 43)	(1 15)	(28)	(6)
VII ..	57.00	57.1	57.1	57.0	57.2
n....	(28)	(16)	(9)	(7)	(5)
VIII..	57.12	57.15	57.13	57.23	57.24
n....	(14 53)	(11 81)	(8 93)	(2 88)	(84)
Total.	57.17	57.20	57.18	57.24	57.28
n....	(36 83)	(31 34)	(24 42)	(6 92)	(1 74)

¹⁾ 1 specimen, 58 vertebrae.

remember that the uncertain herring is not included in the table.—There might also be a summer spawning element present there. The table shows finally that the number of vertebrae tends to increase from stage VII, through VIII and III to IV, a feature which we find repeated in the two Norwegian types (columns 4 and 5) and, partly, in the Icelandic fraction (column 6).

Columns 4 and 5 show that the number of vertebrae is considerably higher in the southern type than in the northern one, the figures being 57.244 and 57.183. If we compare the frequency distribution we get the following figures.

VS	Northern Type %	Southern Type %
<58.....	1.1	1.7
58.....	27.6	30.5
57.....	60.2	58.5
56.....	10.6	9.0
>56.....	0.5	0.3
Total:.....	100.0 %	100.0 %

This difference might at least partly be due to the fact that the northern type is composed of somewhat younger fish than the southern one (Table 6). The total number of herrings at stage III and VIII is almost the same in both types, being 945‰ for the northern and 943‰ for the southern type, but there are relatively fewer herring at VIII and relatively more at III in the northern type than in the southern one.

The Icelandic spring spawners in the N.-coast stock have a higher number of vertebrae than any other tribes in the stock, the average being 57.276. This tribe, as may seem natural, is mixed up with some young herrings of stages I and II (104‰), which are scarcely found in the Norwegian tribes. Another interesting feature is that there are definitely more herrings at VIII than at III, and those at VII are better represented here than in the Atl.-Scand. herring. This might partly be caused by a later spring-spawning at Iceland than at Norway, and partly by the influence of some summer spawners.

This is the first time one has tried to analyse the herring stock of the N. coast of Iceland by means of the scale-structure. This work was carried out by my collaborator, Mr. SIGURLEIFUR VAGNSSON, who died early in this year. He had obtained very great experience through 13 years of intense work, and paid a steadily increasing attention to the structure of the

scales to which he devoted the greatest part of his time during the last year in close collaboration with his Norwegian colleague Mr. THOROLF RASMUSSEN. We have in our possession a huge collection of scales, at least 30,000, covering a period of 10 years, which it would be very desirable to work up in the same way as it has been done here as regards 1949, but as the job can only be done by a specially trained worker, it may possibly be some years before we can take up this kind of work again.

ARNI FRÍÐRIKSSON.

Norwegian Herring Investigations 1949.

Routine work collecting samples for determination of age, length and weight and carrying out vertebrae countings etc. was continued during the winter season.

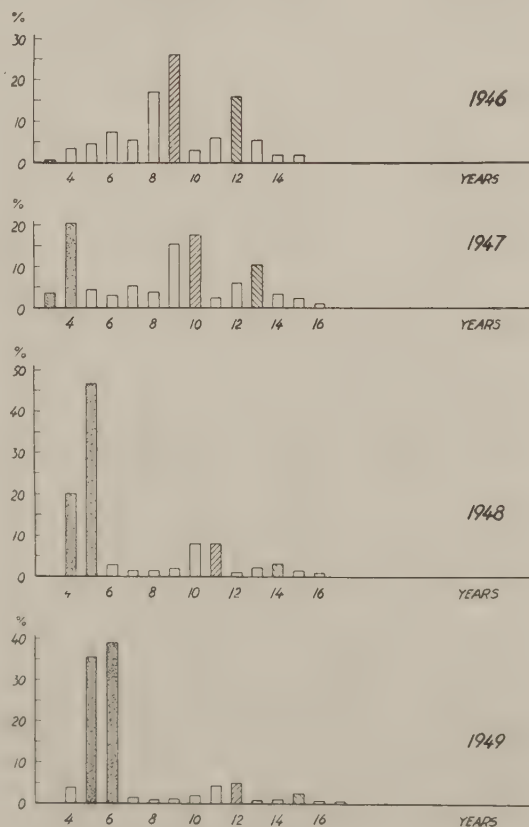
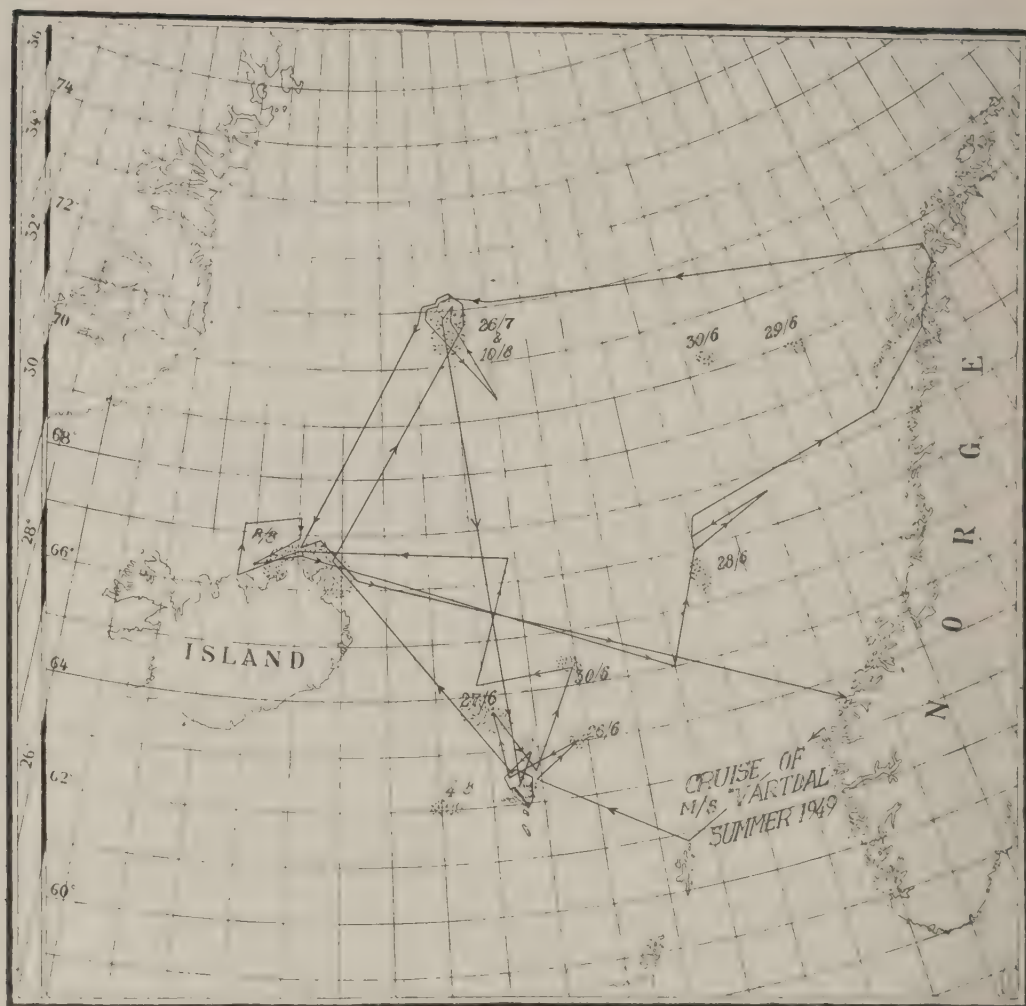


Figure 1. Age distribution in %. Norwegian spring herring.



The weather conditions during the herring fisheries were far from good, but, in spite of this, the herring fishermen succeeded in landing more than 6 million hl. herring, a quantity only once surpassed, in 1948, in the history of the Norwegian herring fisheries.

The age distribution for the spring herring from 1946 to 1949 is given in Fig. 1. The figure demonstrates that two very rich year-classes, the broods from 1943 and 1944, have entered the spawning shoals in 1947, the following year constituting 66% of the total stock. In 1949 these two year-classes constitute about 75% of the stock.

During the summer a cruise was made by a hired ship M/S "Vartdal". The purpose of the cruise was to try and find the herring in the open sea. The map shows the route covered, the dots indicating the positions in which herring shoals were found or reported to be present.

Fig. 2 gives the age distribution of samples secured during the cruise. It is remarkable that we apparently find the same age distribution in samples from the Faroe banks as we find in the samples from northern Iceland.— The samples taken in the Jan Mayen area are to a much greater extent composed of young

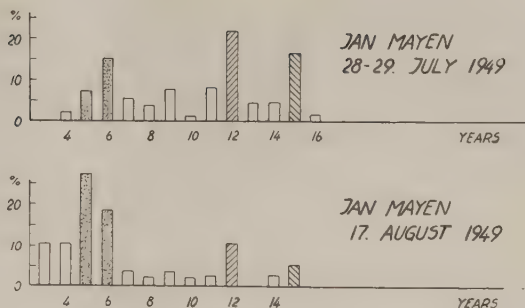
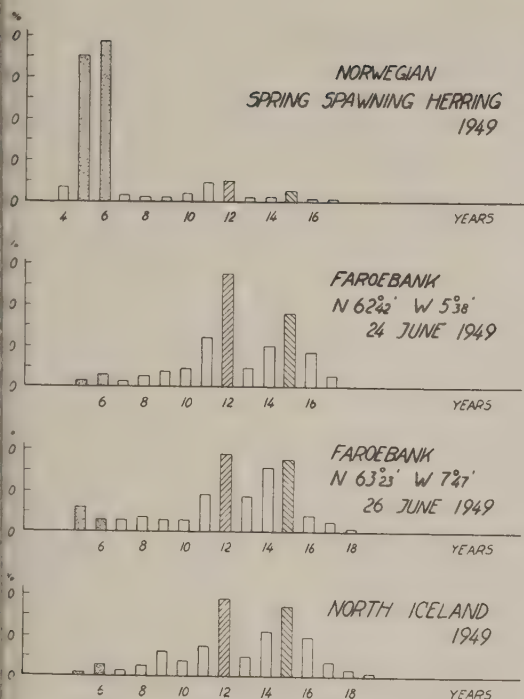


Figure 2. Norwegian Spring Spawning Herring.

herring. The Norwegian spring herring samples from 1949 contain still more young herring, but there can be no doubt that the strong and weak year-classes correspond in all samples, and from investigations of the scale characters it is safe to conclude that all these herring samples have been taken from the same tribe.

FINN DEVOLD.

B. North Sea and adjacent Waters.

1. YOUNG STAGES Scottish Investigations.

1. Larvae.

Newly hatched spring-spawned herring larvae were exceedingly rare in the 1949 records. This may be largely due to the fact that sampling of the known spawning grounds was carried out in March whilst the greatest concentrations of these larvae in previous years have occurred in April. The densest patch of 6–10 mm. larvae in March occurred to the north-west of Shetland. By May, spring-spawned larvae were widely distributed west of Orkney and along the north Scottish coast with one dense concentration off Noss Head.

The first autumn-spawned larvae were taken in the outer Moray Firth in July. This is somewhat earlier than in previous years but the numbers were too small to be of much significance. In August, larvae appeared in greater numbers east of Orkney and on the Peterhead grounds, but hatching did not reach its peak till September when dense concentrations occurred in the same regions and in the Fair Isle

passage. By October there were concentrations of larvae in the Moray Firth and on the Peterhead grounds with an extension of lesser numbers eastward and more particularly, southward as far as the Firth of Forth. By December, larvae were evenly distributed along the whole Scottish coast from Orkney to the Forth. The density of these larvae throughout the season would seem to hold promise of a brood of no more than average abundance.

A. SAVILLE.

2. 0- and I-Group Scotland, 1948–49.

Young herring (0- and I-group) were caught by trawl from the Scottish Research Vessels "Explorer" and "Kathleen" in the bays and estuaries of the Scottish east coast between November 1948 and April 1949. The herring were measured on board and some samples brought ashore to the Marine Laboratory, Aberdeen, for racial investigation. Table 1 gives the particulars of the catches grouped according to area, date and depth.

Table 1. Young Herring Catches by Trawl by Research Vessels in Inshore Waters of the Scottish East Coast.

Area	Firth of Forth, (between Inchkeith and May Island)					Lunan Bay, 56° 39' N. 2° 29' W.	Moray Firth.	
	29th Nov. 1948	8-18th Feb. 1949	24th Mar.-5th April 1949			30th Nov. 1948	Nairn Bay 9th Mar. 1949	Dornoch Firth. 10-11th Mar. 1949
Date	0-20 m.	29-41 m.	0-20 m.	21-40 m.	41-48 m.	11 m.	25 m.	20-37 m.
Depth.	"Kathleen"		"Explorer"		"Kathleen"	"Kathleen"	"Kathleen"	
Vessel cm.								
6	—	+	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—
8	—	+	2.4	—	—	0.9	—	—
9	0.8	0.2	6.0	—	—	31.7	1.3	—
10	7.1	1.8	9.3	—	6.6	62.2	2.5	2.5
11	10.2	10.1	24.6	1.5	22.4	5.2	14.4	16.4
12	26.0	19.8	35.5	9.4	24.2	—	54.4	25.6
13	27.2	26.4	14.5	26.2	16.3	—	25.0	35.7
14	14.6	23.7	4.0	30.4	9.4	—	2.5	16.8
15	11.8	12.4	3.6	15.8	5.6	—	—	2.5
16	2.0	4.7	—	10.9	10.7	—	—	—
17	—	0.7	—	4.5	4.3	—	—	0.4
18	—	0.1	—	0.5	0.3	—	—	—
19	—	+	—	0.2	—	—	—	—
20	0.4	+	—	0.5	—	—	—	—
Mean length, cm.	12.76	13.20	11.63	14.08	12.82	9.72	12.07	12.58
No. of Herring...	253	31800	248	631	713	684	160	856
Vert. S. (No. of Herring)	56.39 (247)	56.44 (478)	—	—	56.42 (311)	56.41 (264)	56.48 (145)	56.50 (244)
No. of hours fishing.....	4	18	6½	5	2	1	1	4
Catch/hour.....	63	1767	40	126	356	684	160	214

The Vert. S counts are characteristic for autumn-spawning stock and there appears to have been very few spring-spawned young herring in the areas sampled.

The catch per hour is considerably greater than that for the previous winter.

In Table 2 are given the particulars for two shore seine catches from the Aberdeen Harbour Channel, which have similar characteristics.

GEORGE MC PHERSON.

Table 2. Young Herring Catches by Shore-Seine in Aberdeen Harbour Channel.

Date	cm.	% Size Distribution					Mean Length cm.
		5	6	7	8	9	
1949							
30th June	30.0	66.5	3.5	—	—	—	5.74
28th July	—	1.8	60.3	35.7	2.0	0.1	7.38
		Date	Number of		Vert. S.		
		1949	Herring		(No. of Herring)		
		30th June	1300		56.34 (329)		
		28th July	759		56.52 (443)		

2. MARKING EXPERIMENTS

Marking of Herring in the North Sea.

Some experiments with a flexible red plastic mark used in double marking of plaice had shown that plastic was very well fitted for fish-marks. It was therefore determined to try a red plastic mark for marking of herring during experimental trawlings on the Fladen Ground during August 1949. The mark used was made of flexible plastic of a bright red colour; the size of the mark was about 35 mm. long and 8 mm. broad, and the mark was stamped DA and a serial number (a hot iron needle being used).

During the later part of August 280 herring were selected for marking out of the catch of short hauls by an ordinary cutter trawl for herring. The herring were immediately placed in a basin with water and marked by help of a "cradle". The mark was fixed by a thin silver wire just anterior to the dorsal fin. Mr. E. BERTELSEN carried out the marking operations.

During the following weeks 10 herring were recaptured at the Fladen Ground by herring fishing boats of various nations. Some of the herring had been somewhat injured by the silver wire, but several had not suffered any damage.

After 16 days one herring was captured north of Dogger Bank, after 18 days another somewhat nearer to this bank (near Tail End). Both were approaching maturity. But later in the autumn no other recaptures were made, showing that fishing of the Fladen Ground stock of herring had probably not been carried out on the actual spawning grounds. Then not before spring 1950 anything was heard about the marked fish. On March 22nd herring DA 385 was however recaptured off Skaw. The fish was spent and very lean (length 27.4 cm., weight 95 gr., 5 winter rings). It had however not suffered from the silver wire. The shortest distance was about 310 nautical miles from the marking locality (58° 08'N., 0° 46'E.) and the fish had been 211 days in the sea. This marked and recaptured herring is the first actual proof that Fladen Ground herring after spawning migrate to Skagerak and Kattegat to spend the winter there. Herring marked by Dr. H. HÖGLUND of Sweden in Kattegat and Skagerak and later recaptured in the North Sea have, however, proved migration in the opposite direction.

This small preliminary experiment in marking herring with a plastic mark has up to now given 13 recaptures (4.6% of the marked 280 specimens). This is a fairly high percentage of recaptures because most of the herring go to oil factories, from which information could not be expected. Further experiments are developing this marking method and a few new and probably better types of plastic marks have been tried during the spring of 1950.

Å. VEDEL TÅNING.

3. COMMERCIAL FISH

Scotland 1949.

"Clupea" surveyed the Forth herring grounds between 18th January and 31st March, and made extensive experimental cruises over the Shetland and Scottish north-east grounds during the summer. Sampling of the shoals was done by a series of drift-nets having different sizes of mesh, supplemented occasionally by samples from commercial catches. Echo sounding surveys were made on a large scale with associated observations on hydrographical and plankton conditions. Herring tagging experiments were carried out whenever practicable, but in this and in many other respects the Scottish work fell far short of its programme

as a result of the scarcity of herring on the usual drift-net grounds after mid-June.

The summer and autumn fisheries at Shetland and along the Scottish north-east coast were very disappointing, the total catch being only about half of that of 1948, which was by no means a successful year. The following are the total drift-net landings for the two years.

Landings in Crans (Drift-net grounds)

	1948	No. of Arrivals	1949	No. of Arrivals
Shetland.....	142,270	5,150	73,890	4,523
Wick to Aberdeen	312,433	20,723	162,447	14,054

The majority of the landings were made before the end of June.

The landings by herring trawlers from the Fladen Ground in 1949, exceeded the total for 1948 but this was achieved by a very appreciable increase in fishing time.

Landings by Trawlers from Fladen Ground.

	Crans	Fishing Hours	Average per 100 hours
1948	48,808	19,804	246
1949	59,287	33,151	179

In the summaries of data percentage values have been used, length is given to the nearest cm., and age has been expressed as the number of winter rings on the scales. The last winter ring is regarded as present in January.

Firth of Forth.

There was no commercial fishing for adult spring-spawning herring in the Firth of Forth during the first months of 1949 owing to scarcity. The following summarises the data relative to adult fish collected by "Clupea".

Size Distribution (cm.), Per Cent.

21	22	23	24	25	26	27	28	29
0.3	0.3	1.5	2.1	10.4	7.0	15.6	30.6	16.2
30	31	32	33	34	35	36	Total	
4.3	4.3	5.8	0.3	0.3	0.6	0.3	327	

Maturities, Per Cent.

IV	V	VI	VII	VII-II
18.7	13.8	63.6	2.8	1.2

Age Composition, Per Cent.

Winter Rings								
3	4	5	6	7	8	9	10—15	
17.1	52.0	14.1	13.1	0.9	—	0.9	1.8	

The outstanding feature of the few herring caught near the mouth of the Forth estuary in 1949 is their unusually large size. The size distribution of the four-year-old fish is almost identical with four-year-old fish caught in March and April in the neighbourhood of the Coral Bank. Comparison is made in the following section.

Samples from the neighbourhood of the Coral Bank.

In March and April of 1949, several English drifters landed catches of herring from the neighbourhood of the Coral Bank—about 70-80 miles west of the south-west coast of Norway.

Size Distribution (cm.), Per Cent.

24	25	26	27	28	29	30	31	32	33	Total
0.1	1.1	2.8	19.0	42.1	27.0	6.0	1.4	0.3	0.1	708

Maturities, Per Cent.

I	II	III	IV	V	VI	VII	VII-II
1.6	5.1	—	0.7	1.3	17.5	53.0	20.6

Age Composition, Per Cent.

3	4	5	6	7	8	9	10-12	Winter Rings
2.3	30.0	12.3	16.2	19.2	10.7	5.5	3.8	

Two distinct adult groups were present in March and April in the neighbourhood of the Coral Bank, one consisting of spawning or newly spent fish and the other of recovered spents. The results of vertebrae counts were as follows:—

Mat.	Winter Rings	54	55	56	57	58	59
IV-VII	4	—	0.9	11.3	50.4	34.8	2.6
VII-II	4	1.5	1.5	28.8	60.6	6.1	1.5
VII-II	5-12	—	2.0	48.5	40.6	8.9	—

The means (and No. of Fish) were 57.27 (115), 56.73 (66), and 56.56 (101) respectively.

The first of the above series represent spawning and newly spent fish and they have the high number of vertebrae typical of northern spring spawners. The second group of four ringers, maturity VII-II, have vertebrae counts typical of a mixture of autumn and

Size Distribution of spring spawning 4 Ringers (A) from Coral Bank and (B) from Forth, Per Cent.

	25	26	27	28	29	30	31	32	Mean	No. of Fish
A	1.7	2.6	24.8	51.3	12.8	6.8	—	—	27.91	117
B	2.4	5.4	23.2	41.1	22.0	3.6	1.2	1.2	27.96	168

spring spawners, while the last group in the series are predominantly autumn or late autumn spawners. There is a reasonable possibility that this last group may be linked up with the autumn spawners which winter in the Skagerak.

While the spring spawning four ringers from the Coral Bank and from the Forth during the spring of 1949 show close similarity with respect to length, it will be seen that the similarity does not extend to the number of vertebrae.

Vert. S.	55	56	57	58	Maturities IV-VII
	0.7	20.6	60.3	18.4	Mean Total
					56.96 141

Shetland.

Very few herring were caught by "Clupea" at Shetland. After mid-June herring were very scarce on the east grounds and "Clupea" spent much time in extensive echo sounding surveys. One commercial sample was obtained from the west coast of Shetland on 2nd November. The following are the chief features of the material collected:

Size Distribution (cm.), Per Cent.

	24	25	26	27	28	29	30	31	32	33	No. of Fish
Date 29/6-12/7	1.1	3.3	8.9	16.7	39.9	22.2	3.3	—	3.3	1.1	90
Date 2/11	3.5	10.8	3.5	6.5	24.2	35.5	15.1	0.9	—	—	231

Maturities, Per Cent.

	I	II	III	IV	V	VI	VII	VII-II
29/6-12/7	2.2	28.9	55.6	5.6	4.4	2.2	1.1	—
2/11	5.6	4.8	5.2	4.3	—	—	9.5	70.6

Age Composition, Per Cent. Winter Rings

	2	3	4	5	6	7	8	9	10
29/6-12/7...	2.2	5.6	10.0	18.9	20.0	13.3	17.8	12.2	—
2/11	17.7	2.2	21.2	3.5	14.3	21.6	6.1	6.5	6.9
2/11-spents..	7.6	1.1	18.4	4.3	17.3	27.0	7.6	8.1	8.6=185

Scottish north-east Coast.

The summaries of samples from the north-east coast are based on catches by "Clupea" supplemented by material from commercial catches. They have been arranged according to distinct phases in the fishery.

Size Distribution, Per Cent.

	20	21	22	23	24	25	26	27	28	29	30
25/5-9/6...	0.4	1.1	4.3	6.0	12.8	15.1	17.1	21.9	15.1	5.7	0.5
11/6-13/7.	1.5	6.6	13.6	16.7	18.3	16.6	10.6	8.5	6.4	1.2	0.1
29/7-12/8.	—	—	0.2	0.4	4.3	11.5	16.0	23.1	25.2	16.5	2.8

Maturities, Per Cent.

	I	II	III	IV	V	VI	VII	VII-II
25/5-9/6...	25.7	36.1	2.6	0.2	—	—	0.2	35.3
11/6-13/7..	41.2	39.6	12.0	2.7	0.5	0.1	—	3.9
29/7-12/8..	12.8	19.4	21.5	22.2	14.1	6.3	3.3	0.4

Age Composition, Per Cent.
Winter Rings

	1	2	3	4	5	6	7	8	9	10+
25/5-9/6...	0.2	12.9	23.6	15.0	10.2	14.7	9.2	8.0	3.0	3.3
11/6-13/7..	0.6	51.5	24.4	9.4	4.8	4.3	2.8	1.4	0.6	0.3
29/7-17/8..	—	4.5	14.7	23.0	12.2	17.4	15.8	6.2	4.9	1.3

The vertebrae counts of the most prominent age-group in each phase of the fishery gave the following results:

Vert. S, Per Cent.

	No. of
	Fish
25/5-9/6 3 Ringers	54 55 56 57 58 59 Mean
16/6-13/7 2 »	— — 38.5 51.9 9.6 — 56.7 135
19/7-17/8 4 »	0.2 4.1 48.8 42.1 4.7 0.2 56.5 580
	0.8 8.4 59.7 26.1 5.0 — 56.3 119

From these figures it is obvious that the early 3 ringers consisted of a mixture of spring and autumn spawners, while the 2 and 4 ringers caught later in the season were derived almost exclusively from autumn spawning stock.

The drift-net fishery off Shetland and off the Scottish north-east coast was almost a complete failure soon after mid-June. An echo-sounder survey by "Clupea" showed that on 27th and 28th June numerous shoals of herring were present along a line extending from 58° 20' N. 0° 45' W. to 59° 10' N. 0° 30' E., or approximately along a line intermediate between the Scottish drift-net grounds and the herring trawling grounds on the Fladen. In this connection it is interesting to note that of 4 recaptured tagged herring, which had been tagged on the drift-net grounds in June, 3 were recovered on the Fladen Ground by trawlers between 25th July and 20th August.

The Fladen Ground.

A series of 5 samples was obtained from herring-trawl catches between 8th August and 11th October. In view of the difficulty of getting good scales from trawl-caught herring strict accuracy in age determinations is not guaranteed.

Although the herring at stages IV-V and at stage VII show a very close agreement in their vertebral counts they differ substantially in age composition. The age of the Fladen

Maturity Stages, Per Cent.

	I	II	III	IV	V	VI	VII	No. of Fish
8/8	0.5	7.4	36.7	32.5	20.7	0.5	1.6	188
23/8	2.5	5.4	12.4	28.5	48.3	2.1	0.8	242
6/9	1.6	5.9	8.2	59.8	13.3	0.4	10.9	257
20/9	3.5	8.5	24.4	22.1	8.9	0.4	32.2	258
11/10	3.2	2.8	20.0	26.0	6.8	1.2	40.0	250

Age Composition, Per Cent.
Winter Rings

	1	2	3	4	5	6	7	8	9	10+
All samples	0.1	1.9	6.2	18.6	10.3	17.8	16.2	14.6	8.1	6.2
Maturities										
IV-V 8/8-6/9	—	—	1.3	4.2	14.3	20.9	19.0	21.1	10.3	8.9
VII 8/8-11/10	—	1.4	0.5	17.6	6.9	16.7	25.5	14.8	12.0	4.6

Vert. S, Per Cent.

	No. of
	Fish
Maturities	54 55 56 57 58 59 Means
I, II, III....	— 3.4 40.7 41.0 13.4 1.6 56.69 322
IV, V	0.2 3.7 51.6 36.0 7.8 0.8 56.50 628
VII	— 4.3 51.9 32.9 10.0 1.0 56.50 210

spents shows a much closer correspondence with that of the spents caught at Shetland in November.

Spring spawning herring were unusually scarce on the Fladen in 1949.

Clyde.

The fishery in the Clyde was very successful during 1949. Analysis has shown that landings have consisted almost entirely of spring spawning herring. Between 80 and 90% of the catch come from the age-group produced in the spring of 1947.

HENRY WOOD.

Herring on the Fladen Ground, at Esbjerg,
and in the Skagerak and northern Kattegat.

Fladen Ground.

A sample caught by trawl on the Fladen Ground in July 1949 is shown in Table 1. It is seen that almost all of the herring are autumn spawners, only of maturity I mixed with a few spring spawners.

The fat content of the herring of maturities I-II was 13.2%, of those of maturity IV, 17.5% (determined by "Fiskeriministeriets Forsøgs-laboratorium", the technological Fisheries laboratory).

Young Herring off Esbjerg.

During July-September 1949 a fishery for small herring for processing took place in the Grådeep at Esbjerg. The mean lengths of these

Table 1. Herring caught by Trawl from a Danish Cutter, July 1949 (125 herrings invest.).

Length Distribution, cm. (%).						
Maturity	18/19	20/21	22/23	24/25	26/27	28/29
I	4	13	3	4	—	—
II—III	—	1	17	9	7	—
IV—V	—	—	5	13	20	4
Total	4	14	25	26	27	4

Maturities and Winter-Rings (%).

Winter Rings	I	II	III	IV	V	Total
1	3	—	—	—	—	3
2	18	—	14	4	—	36
3	2	—	10	7	—	19
4	1	—	5	10	—	16
5	—	—	2	5	—	7
6	—	—	—	3	—	3
7	—	—	1	3	—	4
8	—	—	2	3	—	5
9	—	—	2	3	—	5
10	—	—	—	2	—	2
Total	24	19	17	22	18	100

Racial Characters. (Number in brackets).

Maturity	V. S.	V. P.	K ₂
I	56.58 (31)	23.87	14.68 (28)
II—III	56.44 (43)	23.98	14.86 (48)
IV—V	56.51 (51)	23.80	14.88 (49)
Total	56.50 (125)	23.88	14.81 (119)

herring were 19/7, 7.9 cm.; 15/8, 8.2; 31/8, 9.8. The racial characters were (number in brackets):

	V. S.	V. P.	K ₂
19/7	—	—	14.81 (127)
15/8	56.50 (130)	23.83	15.05 (57)
31/8	56.60 (133)	23.77	14.66 (134)
Total	56.55 (263)	23.80	14.79 (318)

It is not quite certain whether all fish of the three samples belonged to the same race. The difference between V. S. of the two August samples is 0.10 and σ_{diff} 0.092 but between K₂ of the two samples 19/7 and 15/8 combined and the 31/8 sample it is 0.23 while the σ_{diff} is 0.089. Thus the difference in K₂ is about 3 times as great as the σ_{diff} . It appears that the herring are exclusively, or mainly, summer or autumn spawners of the western North Sea. An assumption of a mixing of the 31/8 sample with spring herring is contradicted by the length of these herring.

The fat content of the herring caught 19/7 was 0.74%. The total landing was about 150 tons or about 36 mill. herring.

Table 2. Length Distribution, Maturity, Age and Racial Characters of Herring caught in the Skagerak for Consumption.

Length (percentage).											
Date	15/16	17/18	19/20	21/22	23/24	25/26	27/28	29/30	31	32	33
20/12.48-	—	—	—	—	—	—	—	—	—	—	—
6/1.49...	—	—	1	2	7	37	47	6	—	—	—
31/1-18/2-49	—	—	2	10	14	32	38	3	—	—	—
28/2.49....	0.5	1	18	15	16	21	26	3	—	—	—

Maturity (percentage).

Date	I	II-III	IV-V-VI	VII-VIII
20/12.48-6/1.49	2	13	8	76
31/1-18/2.49	3	38	2	57
28/2.49	21	23	0	56

Rings (percentage).

Date	1	2	3	4	5	6	7	8	9	10	11
20/12.48-	—	—	—	—	—	—	—	—	—	—	—
6/1.49...	1	10	18	20	16	18	11	4	2	1	—
31/1.49-	—	—	—	—	—	—	—	—	—	—	—
18/2.49...	4	20	18	26	18	9	4	2	—	—	—
28/2.49....	25	18	14	13	13	11	4	5	0.5	1	—

Racial Characters (in brackets: numbers).

Maturity	Sample	V. S.	V. P.	K ₂
I	all	56.55 (33)	23.91	14.55 (33)
II-III	20/12-18/2	56.76 (153)	23.94	14.61 (157)
II-III	28/2	56.46 (28)	23.96	14.86 (28)
IV-V-VI	all	56.58 (26)	23.88	14.38 (26)
VII-VIII	all	56.46 (389)	23.89	14.80 (389)

The Trawl Fishery at the Skaw.

Young herring for processing. During the winter and spring season of 1948/49 samples were investigated on 26/10-48, 7/2-49 and 23/3-49. The length and racial characters of the herring were (numbers in brackets) as follows:—

Rings	Length, cm.	V. S.	V. P.	K ₂
0	12—13	56.52 (238)	23.78	14.74 (213)
1	c. 16	56.47 (169)	24.03	14.88 (167)

It is seen that the fish were autumn spawners from the western North Sea.

The fat contents of the 0-ringed were 4.6, 2.3, and 0.7 % respectively in the three samples.

Herring for consumption. During the season of 1948/49 samples were investigated on 20/12-48, 6/1, 31/1, 18/2 and 28/2-49. From Table 2 it is seen that most of the herring had a length of 25-28 cm. and were of maturities VII—VIII. As the season proceeds it becomes gradually more difficult to state if a herring is at stage VIII or (I-) II, and some of the (VIII-) II stage develop to the III stage. From the racial

characters it is seen that this fact cannot explain the increase in the relative number of the herring at the II-III stages as these herring of the first four samples have other racial characters than those at the VII-VIII stages.

The herring at stages VII-VIII are pure autumn spawners from the western North Sea while those at stages II-III are mixtures of these herring and spring herring with a high W. S., either Scottish spring herring or the Norwegian winter herring. It is also seen that in the immature herring at stage I and the maturing and mature herring at stages IV-V-VI these spring herring form a small part while most of these herring no doubt are autumn spawners from the North Sea possibly mixed also with other races.

The fat content of the herring at stages VII-VIII was on 20/12-1948, 7.3%; on 31/1-1949, 5.7—6.5%; 18/2, 4.0, and 28/2, 1.8%. The herring at stage II had on 31/1-1949, 6.7% fat, those at stages II-III, on 18/2, 6.0% and stage I on 28/2-1949, 2.3% fat. It is seen that the fat content decreased heavily during these months.

AAGE J. C. JENSEN.

The East Anglian Herring Fishery in 1949.

Commercial.

1) The number of vessels employed in the 1949 fishery was as follows:—

	Steam Drifters	Motor Drifters	Total
Lowestoft.....	116	56	172
Yarmouth.....	193	108	301
	309	164	473

In the previous year there were 430 vessels operating.

2) The landings of herring during the season were:—

Lowestoft	Yarmouth	Total
131,544 crans ¹⁾	178,787 crans	310,331 crans

3) The average catch per landing was:—

Lowestoft	Yarmouth
49.9 crans	46.4 crans

4) The changes in the "average landing" since 1945 are shown in the following table:—

crans in	1945	1946	1947	1948	1949
Lowestoft...	64.8	51.6	53.3	48.0	49.9
Yarmouth ..	58.7	49.2	46.4	47.7	46.4

¹⁾ 100 crans = 170 Hectolitres.

It will be seen that there are fluctuations in the "average landing" from year to year but at the same time there is a definite downward trend. The Lowestoft figures are greater than those for Yarmouth, mainly because the Lowestoft boats habitually prolong the season by fishing the spawning stocks in the Calais-Gris Nez area, where heavy catches are usually taken.

Biological.

The annual forecast for the East Anglian fishery was issued in August as usual. A rich four-year-old group of herrings was foreseen, as well as a fairly abundant seven-year-old group, and it was also predicted that the season would be late in starting and that the biggest catches would be made during the period of the November full moon. There was to be no "glut" during the October full moon.

Figure 1 shows the calculated age-composition of the shoals in 1949 compared with the actual age-composition which resulted from the examination of some 2,800 scales. For the purposes of the forecast, the expected age in 1949 was obtained by applying the various mortality rates to the 1948 age-composition, and this figure shows the degree of accuracy of the calculations.

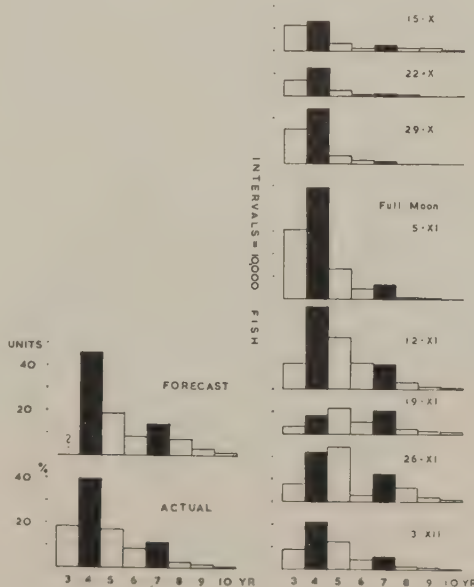


Figure 1.

Figure 2.

There is at present no adequate method of estimating the recruit stock of three-year-old herrings since they are not caught as two-year-old fish, so it is necessary to wait until they arrive in the commercial shoals before any estimation of their numerical strength can be made. The presence of 18% of these fish in the 1949 catches is a fairly good sign for the future.

So far as the whole season is concerned, Figure 2 gives the complete picture. Each histogram represents the "average catch" of all the drifters working from Lowestoft for the weeks in question, and the columns show actual numbers of fish (in units of 10,000 fish) which were taken from each age-group. The quantities of fish landed in each week are therefore directly comparable with each other.

Although the first full moon of the season occurred on October 7th there was no "glut" at that time. Indeed, there were so few herrings on the grounds that it was impossible to obtain samples for the laboratory before the week ending October 15th.

The effect of the November full moon is clearly seen in this figure and by November 19th the catches were again low, so there was no doubt whatever that there was only one period of heavy catches during the season.

The rise in the catches during the last two weeks was due to another cause. After the 19th November the quantity of herrings on the local East Anglian grounds was so meagre that the drifters from Lowestoft left the area and went south to Sandettié and Cap Gris Nez where they encountered the fish which had migrated south after passing the East Anglian grounds. Here, the drifters made good catches up to 10th December.

A general estimation of the "quality" of the East Anglian herrings is shown in Figure 3 which shows the average weight in ounces¹⁾ of fish of each age during the seasons 1946, 1947 and 1949. (Owing to an error in the weighing machine which was not discovered

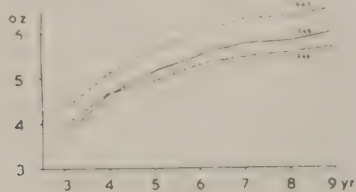


Figure 3.

¹⁾ 1-oz = 28.35 gm.

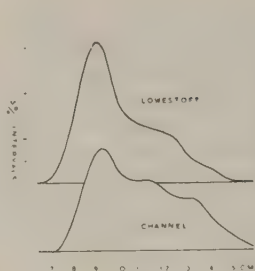


Figure 4.

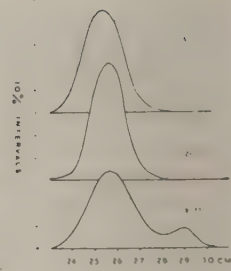


Figure 5.

until the end of the 1948 season, and for which no correction could be made, the figures for that season were useless and have therefore been omitted).

This figure shows that there is a possibility of a wide variation in the weight of the East Anglian herrings from year to year and work which is at present in hand is showing that there is a distinct relationship between the weight of these herrings and the amount of fat contained in the summer plankton on which they feed.

An interesting comparison was made between the herrings caught on the East Anglian grounds and those caught later in the season in the eastern part of the Channel. The length L_1 for all the four-year-old fish examined in each area was calculated, and the frequency curves in Figure 4 show the high degree of similarity which was obtained, suggesting that the two lots of fish are from the same stock.

During the 1949 season definite evidence of an incursion of "foreign" herrings into the East Anglian shoals has been obtained and this took place during the two weeks 19th and 26th November (see Figure 2). During those periods it was noted that the number of 5-year-old fish exceeded the number of 4-year-olds, and an examination of the length-frequency curves of the 5-year-old fish showed that an additional group of herrings of that age had come into the shoals.

Figure 5 shows the length of these herrings during the weeks 5th, 12th and 19th November and the additional mode at 29 cm. during the latter period shows that herrings of an entire new growth-type had appeared in the shoal.

How different these fish were from the East Anglian herrings can be seen from the scale types in Figures 6, 7 and 8.

Figure 6 shows a typical 5-year-old scale of a southern North Sea herring, with the almn

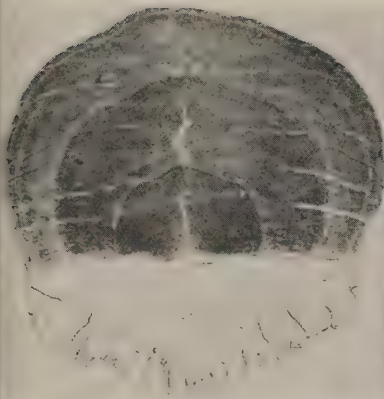


Figure 6.

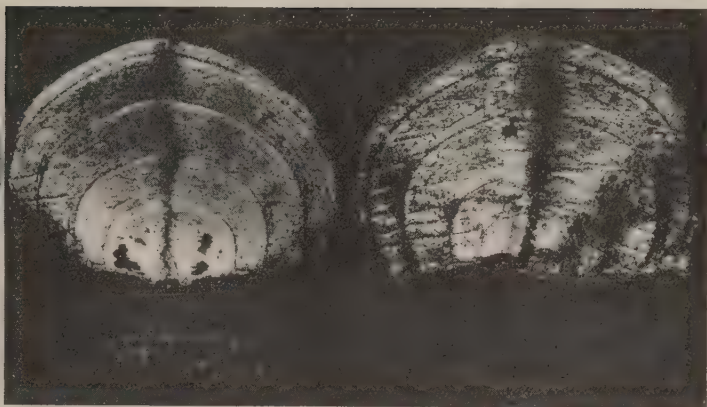


Figure 7. Scale of a »foreign«
5-year-old herring caught off East Anglia.

Figure 8.

equal first and second zones and the very much reduced third and fourth zones.

Figures 7 and 8 are scales of the "foreign" herrings and in both cases the third zone is greater than the second, and although the photographs may not show it clearly, the fourth ring in each case is broader than the first three rings which are very "hard" and this characteristic suggests that the fish come from an area very much further to the north.

W. C. HODGSON.

The Dutch Herring Fisheries in 1949.

Drift-Net Fisheries.

The charts of the Dutch herring season 1949 have been prepared in the same way as in the previous years. This year, data were collected from about 110 vessels covering 50% of the fishing activity of the whole lugger fleet. The number of nets used per ship rose gradually from 40, when the fishery started about mid-May, to 100 in the second half of June. The number remained at 100 in the other months. The nets were set either for surface or for deeper water fishing.

More ships than in 1948 gave information about the quality of the herring caught on the different grounds. The charts Nos. 24—31

indicate what qualities (matjes, full, spawning, spent) contribute an important part (more than about 25%) of the total quantity caught.

The distribution of the fleet was the same as in 1948. The catches per shot in the months of May and of October-December remained about equal to those in the corresponding months of 1948, but the catches in the months of June-September were much below those of 1948.

Table 1B gives the total quantity of drift-net herring landed. In all months except November the total amount landed was below that of the corresponding months of 1948. The total weight landed in 1949, calculated in kg., is 63,117,131 kg.

J. DE VEEN.

Trawl Fisheries.

The charts Nos. 17—23 show that the catch per 100 hours fishing of the steam trawlers has remained at about the same level as in 1948. Table 1A gives the quantity of herring landed by the trawlers and by the whole fleet fishing with trawl-nets. The total quantity landed is below that of 1948 mainly due to decreased landings in August-November. This does not only hold for the steam trawlers, but also for the other types of vessels.

L. K. BOEREMA.

Number of Shots.

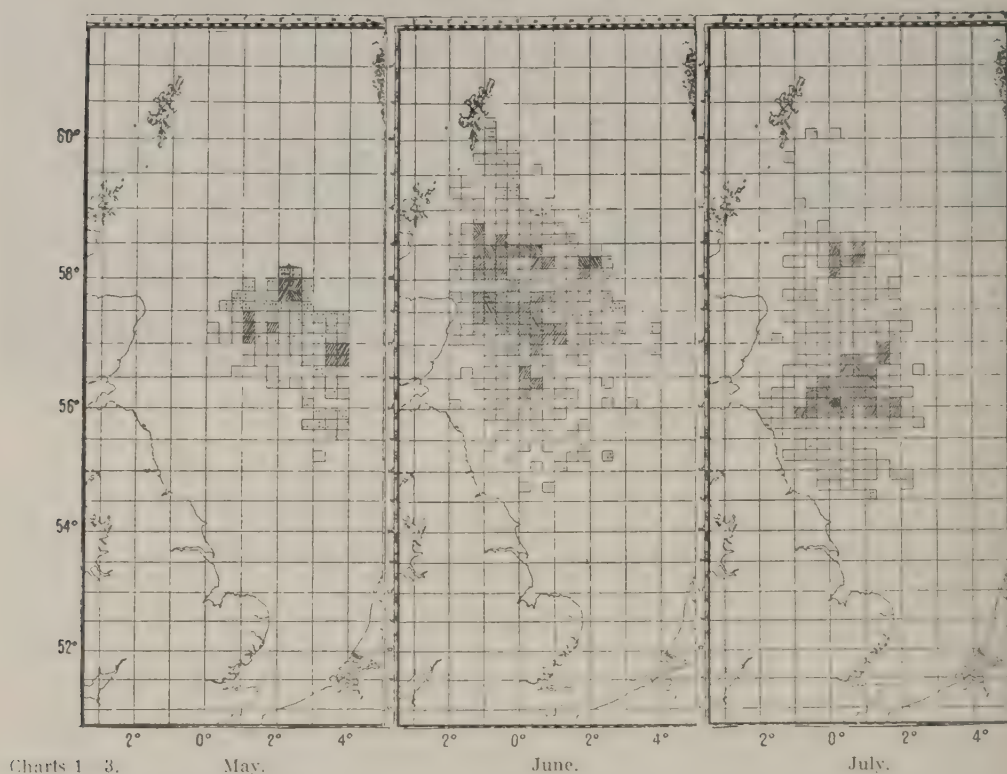
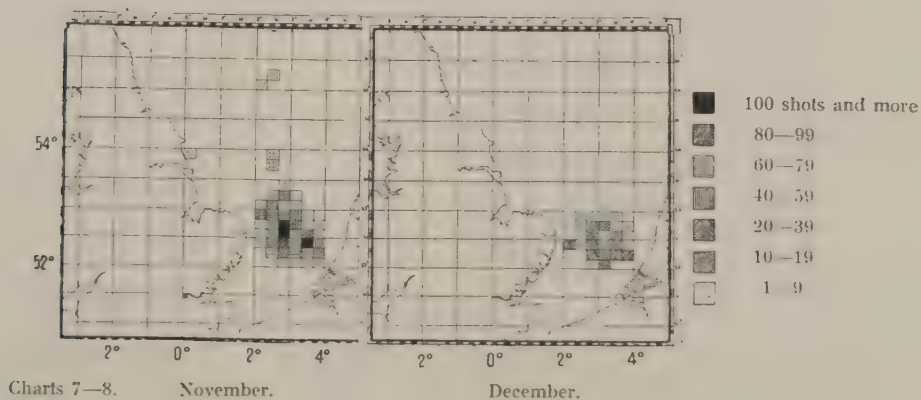
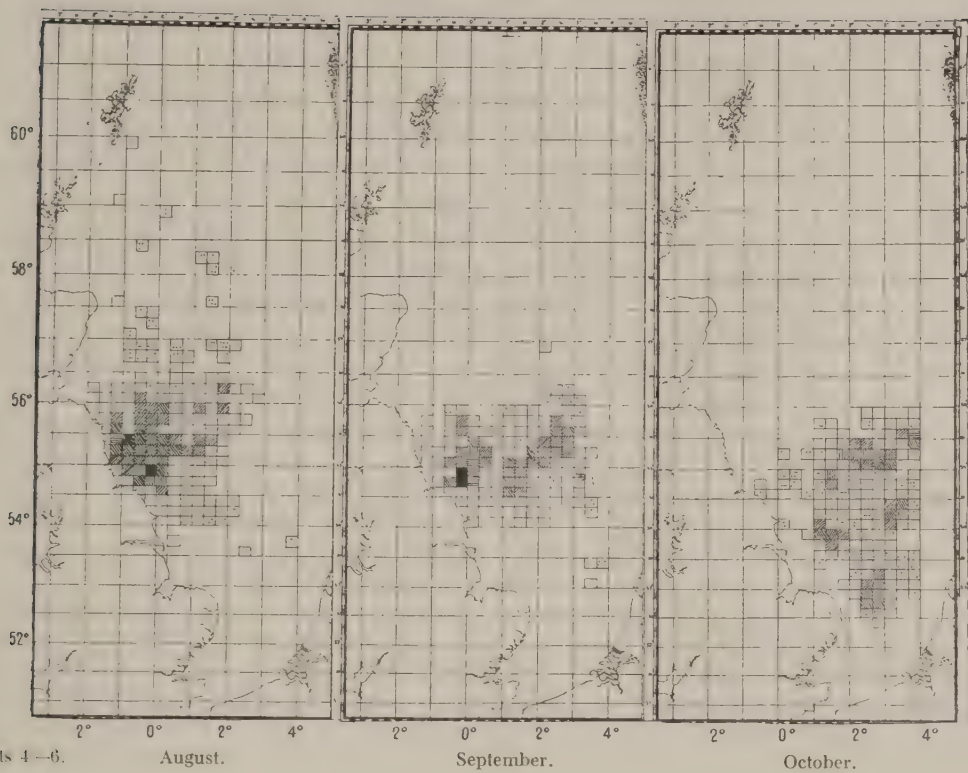


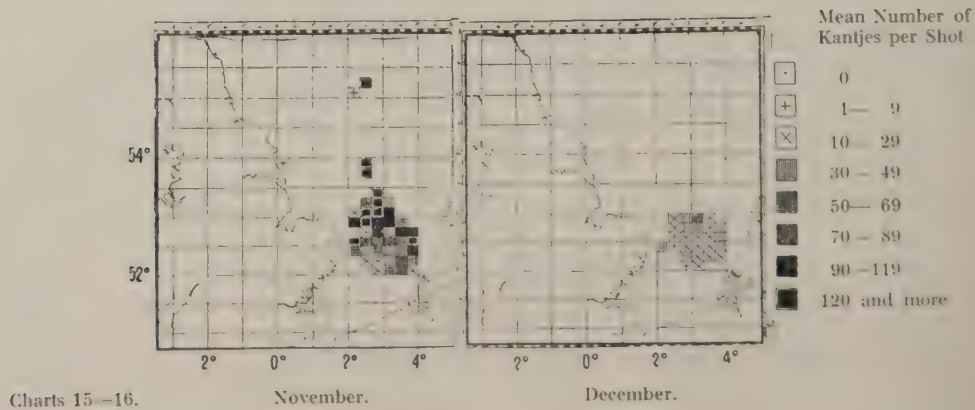
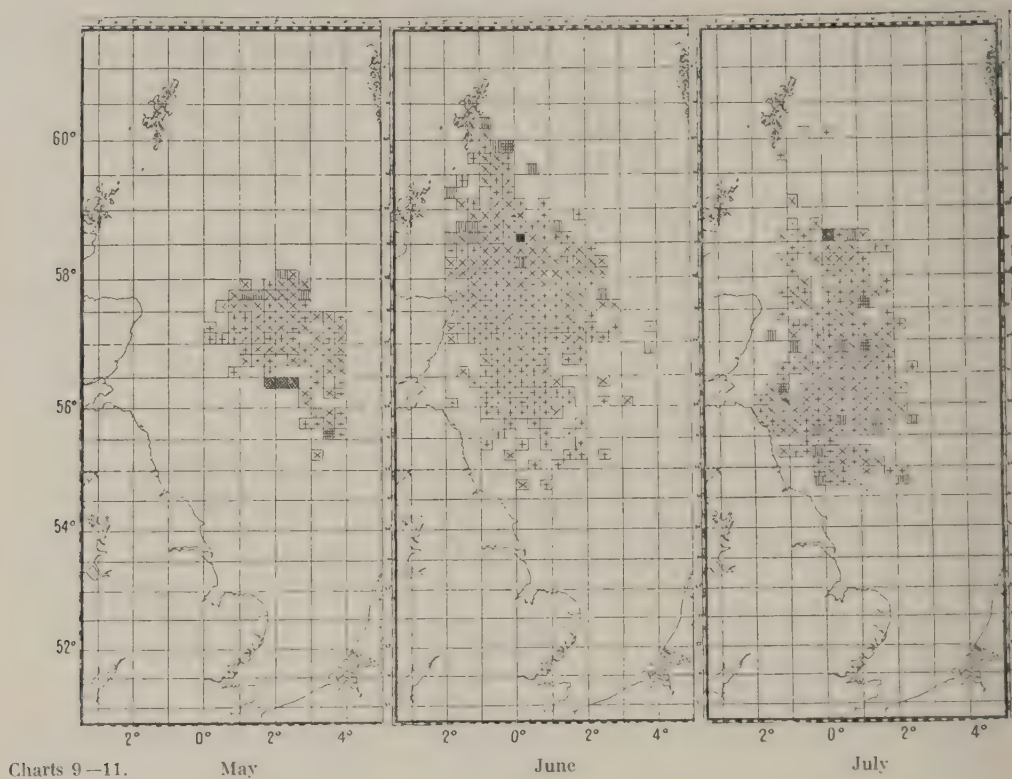
Table 1. Quantities of Herring landed in Dutch Ports in 1949.

A. Trawled Herring (tons).			B. Herring landed by the Luggers fishing with Drift-Nets.				
Month	Trawlers	All kinds of vessels	Salted Herring (in kantjes of 94 kg.)			Fresh herring (in kg.)	
			Gutted		Ungutted		
			Matjes	Full	Spent		
January	73	2,153	—	—	—	305	
February	515	1,456	—	—	—	—	
March	217	218	—	—	—	—	
April	92	93	—	—	—	—	
May	36	37	12,324	—	—	90	
June	9	9	31,841	—	—	995	
July	1,951	2,005	41,799	53	—	1,616	
August	4,697	5,100	39,762	7,961	266	511	
September	4,410	4,922	9,724	66,143	6,721	11,960	
October	3,539	3,915	—	58,026	11,134	70,153	
November	721	721	—	8,283	629	251,036	
December	58	177	—	526	329	57,144	
Total 1949	16,318	20,806	135,450	140,992	19,079	393,810	
						8,320,017	

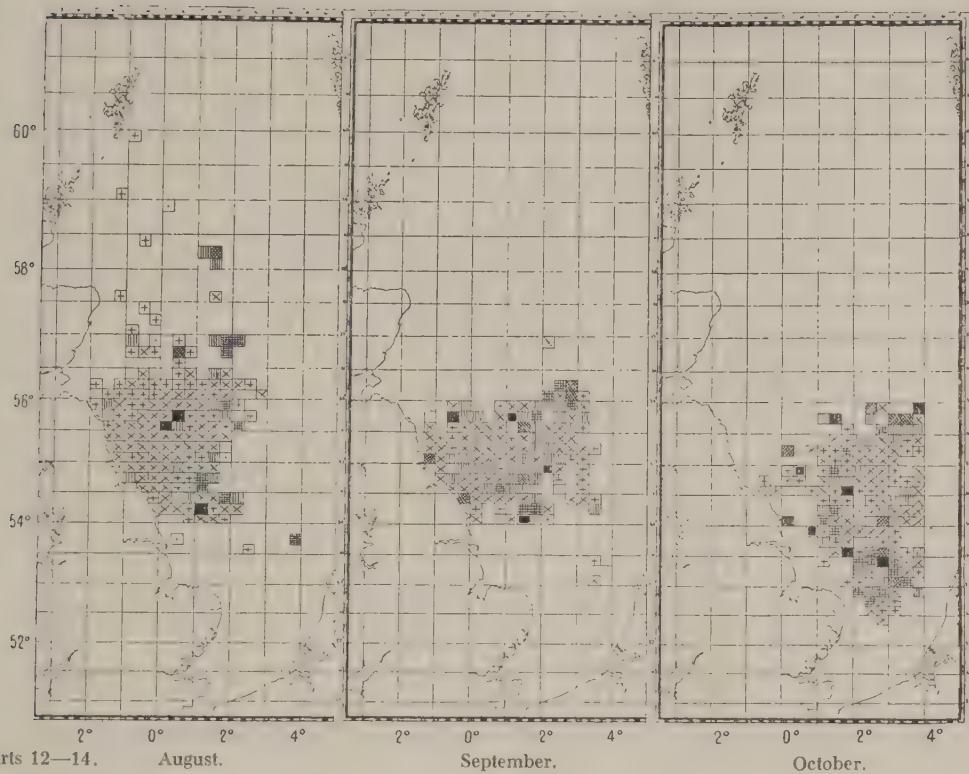
Number of Shots.



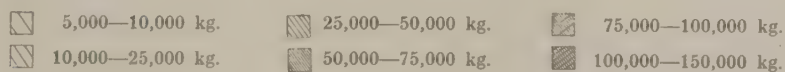
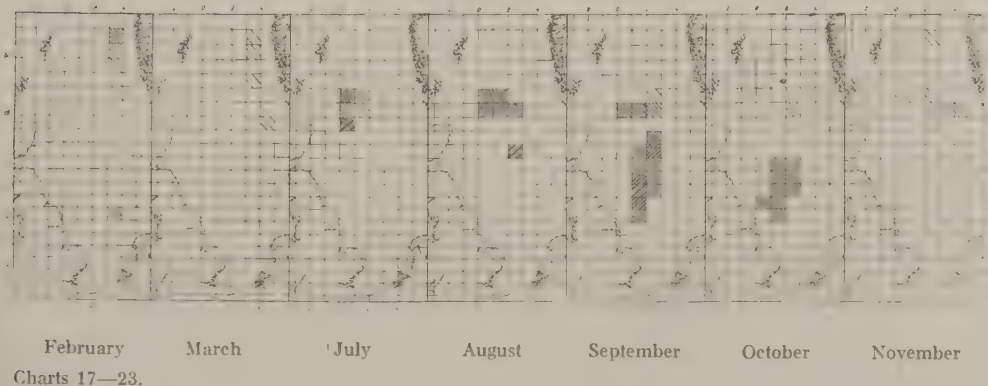
Mean Catch per Shot (in kantjes).



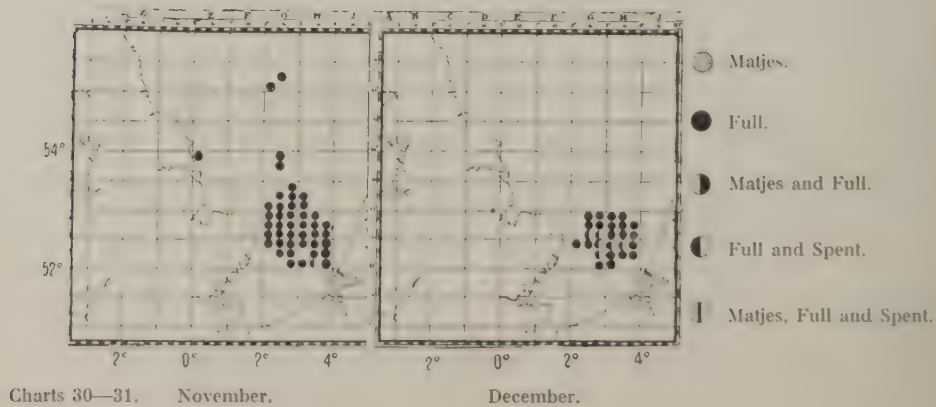
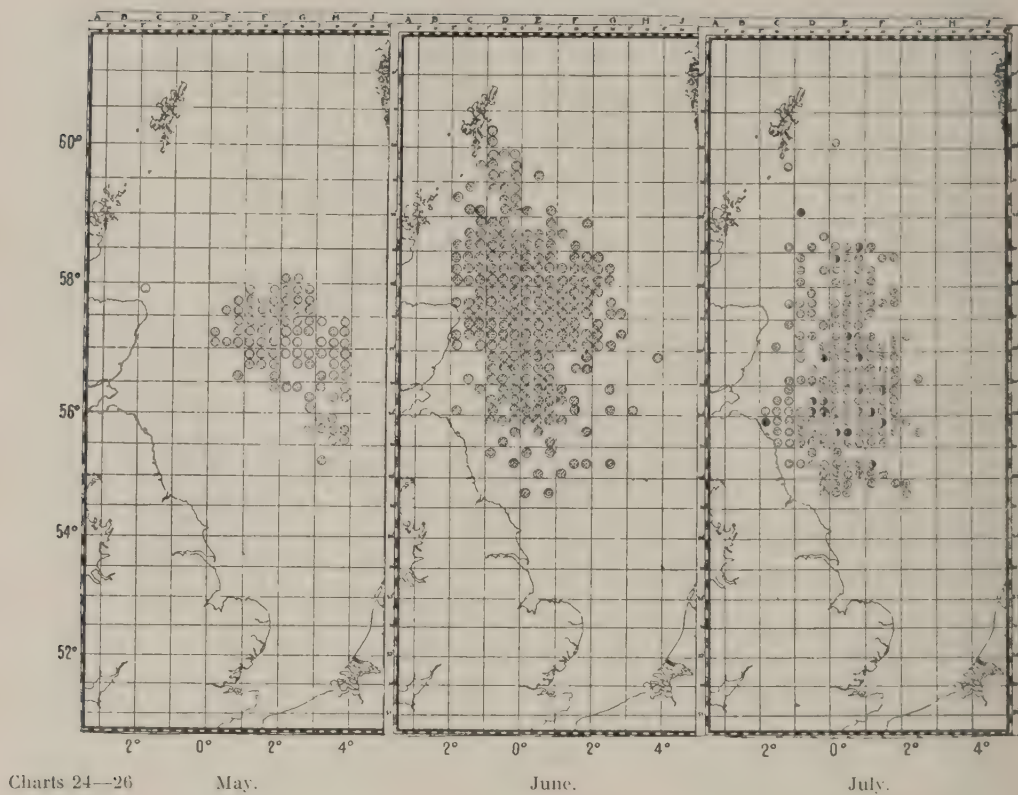
Mean Catch per Shot (in kantjes).



Mean catch (in kg.) per 100 hours fishing of the steam trawlers.

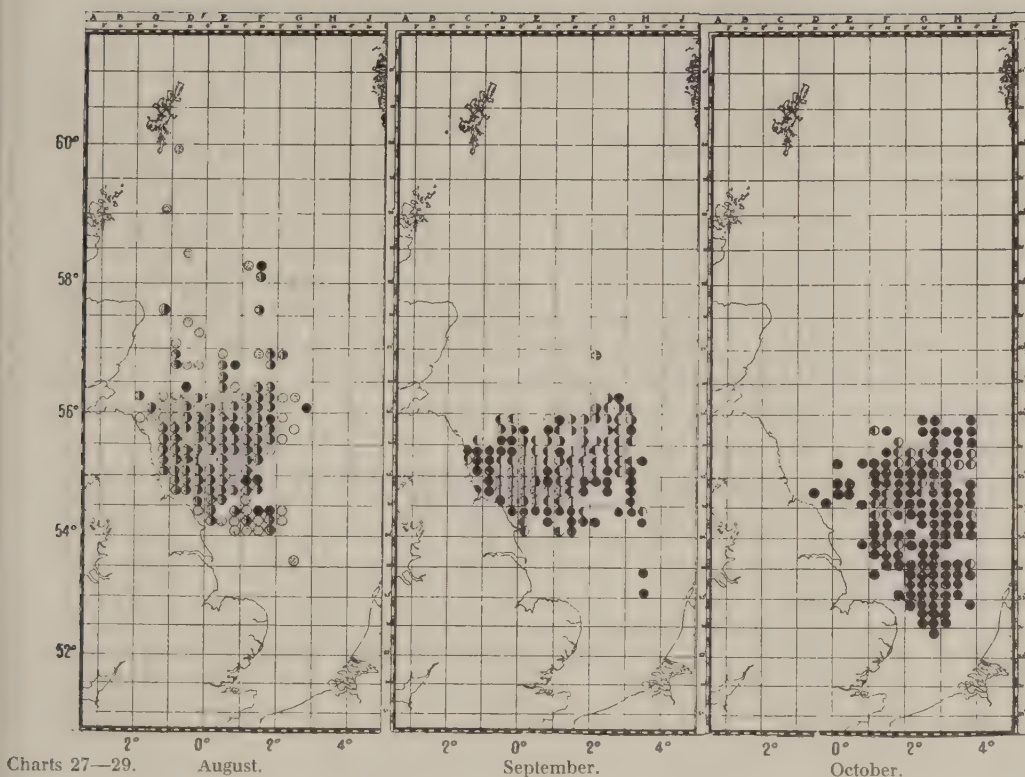


Sorting.



- Matjes.
- Full.
- ◐ Matjes and Full.
- ◑ Full and Spent.
- ◒ Matjes, Full and Spent.

Sorting.

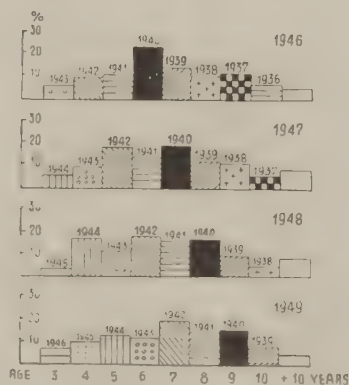


Concentrations of Full Herring exploited by the Belgian Herring Trawlers in 1949.

A. Activity of the Herring Trawlers and Results recorded during the Fishery.

The first full-herring catches taken by the Belgian herring trawlers were landed on 13. July and the last on 5. December 1949. During July and August, the catches came exclusively from the Fladen Ground, whereas from September onwards, many trawlers already fished south of this area, viz., on the Turbot Bank, Old Devil Hole, and Gut. In October, this fishery extended to Brucey's Garden and the SW. area of the Dogger Bank. In November, the whole fishery moved suddenly to the extreme south of the North Sea, where it was localised between the "Ruytingen", the "Sandet-tié", and the Straits of Dover. There the fishery ended on 5. December.

The effectiveness of the trawler fleet is shown by Tables 1—4.



Biological Scale of the Full-Herring Concentrations exploited by the Belgian Herring Trawlers during the years 1946—1949.

Table 1. Number of the Belgian Herring Trawlers (t), and of their Voyages (v).

Classes of Vessels											
III (160- 200 H. P.)		IV (270- 300 H. P.)		V (400- 450 H. P.)		VI (550- 850 H. P.)		Total			
t	v	t	v	t	v	t	v	t	v		
(a) According to the fishing grounds											
Fladen	—	—	2	2	7	36	13	52	22	90	
Centr. Area ¹⁾	—	—	—	—	7	38	9	26	16	64	
South. Area ²⁾	6	8	2	2	4	7	1	1	13	18	
(b) According to the monthly periods.											
July	—	—	—	—	7	9	6	8	13	17	
August	—	—	2	2	7	19	13	27	22	48	
September	—	—	—	—	7	20	13	28	20	48	
October	—	—	—	—	7	20	5	12	12	32	
November	6	7	2	2	5	12	2	4	15	25	
December	1	1	—	—	1	1	—	—	2	2	

¹⁾ Central Area of the North Sea, chiefly "Old Devil Hole", "Turbot Bank", "Gut", "Brucey's Garden" and S.W. area of the Dogger Bank.

Table 2. Number of Sea-Days (S.D.) and of Effective Fishing Hours (F.H.).

Classes of Vessels							
III		IV		V		VI	
S.D.	F.H.	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.
(a) According to the fishing grounds							
Fladen	—	—	29	300	391	3730	540
Centr. Area	—	—	—	—	338	2620	251
South. Area	62	747	17	206	48	446	4
(b) According to the monthly periods							
July	—	—	—	—	103	1143	73
August	—	—	29	300	195	1646	279
September	—	—	—	—	203	1930	299
October	—	—	—	—	166	1267	111
November	60	737	17	206	105	780	33
December	2	10	—	—	5	30	—

²⁾ Southern Area of the North Sea, chiefly the area situated between the "Ruytingen", "Sandettie" and Straits of Dover.

Table 3. Number of H.P. developed (1000 H.P.) and of Landings (1000 Kg.) (L.).

III		IV		V		VI	
H. P.	L.	H. P.	L.	H. P.	L.	H. P.	L.
Fladen	—	—	90	41	1528	1626	3966
Centr. Area	—	—	—	—	1068	1790	1525
Southern Area	128	36	57	12	178	125	11
July	—	—	—	—	472	308	389
August	—	—	90	41	674	951	1968
September	—	—	—	—	786	1017	2507
October	—	—	—	—	519	984	531
November	126	36	57	12	312	277	107
December	2	0.3	—	—	12	4	—
% December	—	0.4	—	0.6	—	40.3	—

Table 4. Average Catch (1000 Kg.) per Voyage (C. V.), per Sea-Day (C. S.D.), and per Hour for 100 H.P. developed (C/H).

III			IV			V			VI		
C./V.	C./S.D.	C./H.	C./V.	C./S.D.	C./H.	C./V.	C./S.D.	C./H.	C./V.	C./S.D.	C./H.
Fladen	—	—	20	1.4	45	45	4.2	106	71	6.8	93
Centr. Area	—	—	—	—	—	47	5.3	167	55	5.7	94
Southern Area	4	0.6	28	6	0.7	22	18	2.6	70	49	12.2
July	—	—	—	—	—	31	3.0	65	45	4.9	92
August	—	—	20	1.4	45	50	4.9	141	78	7.5	107
September	—	—	—	—	—	51	5.0	129	69	6.5	77
October	—	—	—	—	—	49	5.9	189	52	5.6	117
November	5.1	0.6	28	6	0.7	22	23	2.6	89	36	4.3
December	0.3	0.1	14	—	—	—	4	0.7	30	—	—
Total	4.5	0.6	28	13	1.2	36	44	4.6	128	65	6.5

Table 5. Recapitulation of the Activity of the Herring Trawlers during the Full-Herring Campaigns 1946 to 1949.

Details	Classes of Vessels	Campaigns							
		1946		1947		1948		1949	
		t	v	t	v	t	v	t	v
Number of Herring Trawlers in Activity (t), and Number of Voyages (v)	III	8	12	4	5	16	33	6	8
	IV	26	156	37	169	42	161	4	4
	V							7	81
	VI	12	89	19	141	22	138	13	79
	Total	46	257	60	315	80	332	30	172
Number of effective fishing Hours	III	793	—	312	—	1,183	—	747	—
	IV	1,102	—	18,655	—	16,640	—	506	—
	V							6,796	—
	VI	6,812	—	14,339	—	12,376	—	7,496	—
	Total	18,707	—	33,306	—	30,199	—	15,545	—
Number of 1000 H. P. developed	III	155	—	56	—	199	—	128	—
	IV	2,958	—	5,485	—	5,315	—	147	—
	V							2,774	—
	VI	4,301	—	9,126	—	8,080	—	5,502	—
	Total	7,414	—	14,667	—	13,594	—	8,551	—

Table 6. Weight of Full-Herring landed during the Years 1946—1949.

Details	Classes of Vessels	Years			
		1946	1947	1948	1949
Weight landed (1000 Kg.)	III	230	44	307	36
	IV	4,726	4,560	4,040	53
	V				3,541
	VI	5,985	9,761	9,784	5,164
	Total	10,941	14,365	14,131	8,794
Average Weight per catch (1000 Kg.)	III	19	9	9	4
	IV	30	27	25	13
	V				44
	VI	67	69	71	65
	Total	43	45	43	51
Average Catch per Hour and per 100 HP. (Kg.)	III	148	80	154	28
	IV	160	84	76	36
	V				128
	VI	139	107	121	94
	Total	147	98	104	103

Table 7. Seasonal Values recorded for the Years 1946 to 1949 (1000 Frs.).

Years	Classes of Vessels				Total	Price per Kg.
	III	IV	V	VI		
1946	513	18,437		27,241	46,191	4.22
1947	278	16,987		38,703	55,968	3.97
1948	784	13,158		32,335	46,277	3.27
1949	223	162	9,511	12,658	22,555	2.56

Table 8. Percentage Distribution of each Centimetre Class, Mean Length (cm.), Average Weight, and Percentage of Males.

cm.	21	22	23	24	25	26	27	28	29	30	Mean	Aver. weight	% males
N. Area	—	0.2	1.0	1.7	5.9	15.5	30.2	34.2	10.0	1.3	27.6	165 gr.	55.5
S. Area	1.1	3.2	8.9	10.5	11.7	14.6	28.9	17.1	3.8	0.2	26.4	142 »	52.0
August	—	—	—	0.7	9.0	18.6	30.2	31.2	8.6	1.7	27.5	165 »	57.6
September	0.7	0.4	3.6	4.2	3.3	12.0	31.3	33.1	10.7	0.7	27.5	160 »	47.3
October	0.9	4.2	10.4	12.5	13.8	14.9	27.1	14.2	2.0	—	26.2	136 »	56.7
Total	0.5	1.6	4.8	5.9	8.7	15.1	29.5	26.1	7.0	0.8	27.0	154 »	53.8

Table 9. Percentage Distribution of each Stage of Maturity, and of Quantity of Mesenteric Fat.

Stage of Maturity	I	II	III	IV	V	VI	VII	VIII-II	Fat 0	1	+	M
Northern Area	0.1	1.2	6.1	16.4	54.4	20.3	0.7	0.9	24	50	10	16
Central Area	0.2	1.1	1.3	3.7	16.2	67.6	4.1	5.9	46	46	4	5
August	0.2	1.7	7.4	22.6	62.4	5.0	0.7	—	14	49	14	22
September	0.4	1.3	4.2	9.1	38.0	42.0	1.3	3.6	36	46	7	10
October	—	0.4	—	—	9.8	78.9	4.9	6.0	52	47	0.4	0.4
Total %	0.2	1.1	3.8	10.3	36.1	42.8	2.4	3.3	34	48	7	11

Percentage distribution of mesenteric fat in {	1st group, maturities I-III	—	2	21	77
	2nd group, maturities IV-VIII (II)	38	52	6	5

Table 10. Percentage Distribution of each Year-Class observed and Number (No.) of readable Scales, and Age-Groups of total catch compared for 1946-49.

Winter rings	2	3	4	5	6	7	8	9	+	No.
Age (Years)	3	4	5	6	7	8	9	10	+	
Year-Classes in 1949 catch.	1946	1945	1944	1943	1942	1941	1940	1939	before 1939	
Northern Area . . .	1.1	3.4	11.3	12.8	18.5	20.8	19.2	9.1	3.8	265
Central Area	8.0	15.1	13.2	10.0	19.9	7.9	13.5	6.4	6.0	251
August	—	2.6	13.5	12.9	20.2	21.8	17.1	8.3	3.6	193
September	3.1	4.6	10.1	9.3	19.4	16.3	20.9	10.1	6.2	126
October	9.8	18.6	12.4	11.3	18.0	6.2	12.9	5.7	5.1	194
1946	4.4	9.5	11.5	23.9	14.3	10.7	11.3	7.4	4.8	
1947	5.3	8.7	17.2	13.7	18.7	11.9	10.9	4.4	9.1	
1948	1.1	16.7	9.4	17.6	15.3	16.7	9.7	4.5	8.7	
1949	4.5	9.1	12.2	11.4	19.2	14.5	16.5	7.7	4.9	

Table 11. Average Size (cm.) observed for each Year-Class.

Herrings born in	Age (Years)	Origin Areas		Monthly Periods			
		North.	Centr.	Aug.	Sept.	Oct.	Total
1946	3	23.6	23.3	—	24.1	23.2	23.3
1945	4	25.4	24.9	25.9	24.9	24.9	25.0
1944	5	26.9	26.1	26.9	27.0	25.8	26.5
1943	6	27.0	26.7	27.0	26.9	26.7	26.9
1942	7	27.6	27.3	27.6	27.5	27.1	27.5
1941	8	28.0	27.5	28.0	28.2	27.7	28.0
1940	9	28.3	27.9	28.0	28.4	27.8	28.1
1939	10	28.4	28.2	28.6	28.2	28.2	28.3

Table 12. Average Value of L₁ (mm.) of each Year-Class.

Areas	Year-Classes							
	1946	1945	1944	1943	1942	1941	1940	1939
Northern . .	133	109	113	115	115	118	119	12
Central . . .	123	109	109	113	113	112	115	11
Total	124	109	111	114	114	117	117	11

General Average value of L₁:

Northern Area :	116 mm., August	: 116 mm.
Central Area :	113 mm.; September:	119 mm.
Total :	115 mm.; October :	110 mm.

Table 13. Percentage Distribution of the Number of Vertebrae and the vertebral Average.

Number of vertebrae		55	56	57	58	59	Total	Averages	
								1st group	2nd group
Northern Area		2.5	46.8	45.3	5.0	0.4	56.541	56.73	56.53
Central Area		3.4	45.5	46.4	4.5	0.2	56.525	56.73	56.52
Total		2.9	46.2	45.8	4.8	0.3	56.533		
August		2.2	48.2	44.6	4.3	0.7	56.532	56.69	56.52
September		0.2	44.3	47.5	5.7	2.3	56.573	56.77	56.57
October		4.3	46.2	45.2	4.3	—	56.495	56.50	56.50
Total		2.9	46.2	45.8	4.8	0.3	56.533	56.74	56.52
1st group		0.9	34.9	54.7	8.5	0.9	56.735		
2nd group		3.1	47.2	45.0	4.5	0.2	56.515		

Table 14. Percentage Distribution of the Number of cervical Vertebrae and the cervical vertebral Average.

Numb. C. Ver.	21	22	23	24	25	26	27	28	Total	Averages	
										1st group	2nd group
Northern Area.....	0.2	2.4	29.4	46.5	17.9	2.9	0.4	0.3	23.92	23.96	23.91
Central Area.....	—	1.8	29.5	46.5	16.0	4.7	1.3	0.2	23.96	24.20	23.96
August.....	0.2	3.6	29.0	49.6	14.4	2.6	0.2	0.2	23.84	23.90	23.84
September.....	—	0.9	29.4	43.4	20.5	3.9	1.6	0.2	24.03	24.08	24.02
October.....	—	1.8	29.9	46.6	16.1	4.7	0.7	0.2	23.95	23.50	23.95
Total.....	0.1	2.1	29.4	46.5	17.0	3.9	0.8	0.2	23.94	24.00	23.94
1st group.....	—	2.8	20.7	55.7	17.0	1.9	1.9	—	24.00		
2nd group.....	0.1	2.0	30.2	45.7	17.0	4.0	0.8	0.2	23.94		

Table 15. Average Number of cervical Vertebrae for each Total Number of Vertebrae.

Total number of vertebrae.....	55	56	57	58	59	Total
Number of spines observed.....	38	598	593	62	4	1295
Average number of cerv. vert.....	23.29	23.77	24.11	24.44	23.75	23.94

Table 16. Percentage Distribution of the keeled Scales (K_2).

Number of K_2	12	13	14	15	16	17	18	Total	Averages	
									1st group	2nd group
Northern Area.....	—	5.9	33.7	41.4	16.5	2.3	0.2	14.76	14.59	14.77
Central Area.....	0.3	4.3	28.9	45.3	18.3	2.2	0.7	14.86	14.65	14.87
Total.....	0.1	5.2	31.4	43.2	17.4	2.3	0.4	14.81	—	—
August.....	—	5.5	31.7	43.8	16.9	1.9	0.2	14.79	14.64	14.80
September.....	0.2	5.6	34.8	39.6	16.9	2.7	0.2	14.76	14.53	14.81
October.....	0.2	4.5	27.8	46.3	18.3	2.2	0.7	14.87	15.00	14.87
Total.....	0.1	5.2	31.4	43.2	17.4	2.3	0.4	14.81	14.58	14.83
1st group.....	0.9	8.3	40.4	36.7	10.1	3.7	—	14.58		
2nd group.....	0.1	4.9	30.6	43.8	18.0	2.2	0.4	14.83		

B. Some Considerations about the Exploitation of the Full-Herring Shoals and on the Results obtained.

In 1949, the herring trawlers were less active than usual. The number of trawlers as well as of voyages decreased (see Table 5); the same applies to the number of sea-days, the hours of effective fishing and the number of H.P. developed.

This smaller activity of the herring fleet entailed inevitably a marked diminution in the total weight landed (see Table 6). As a set-off, the average weight per catch shows a large increase with reference to the averages recorded in previous years. In comparison with 1948 and 1947, the average catch per hour's effective fishing stayed rather stationary, whereas a maximum was attained in 1946.

Looking at Table 7, we ascertain a formidable regression in the value in reference with previous years. This deficit must for the greater part be attributed to the diminution of the total weight landed and to the average price paid for the herring, which was rather derisory.

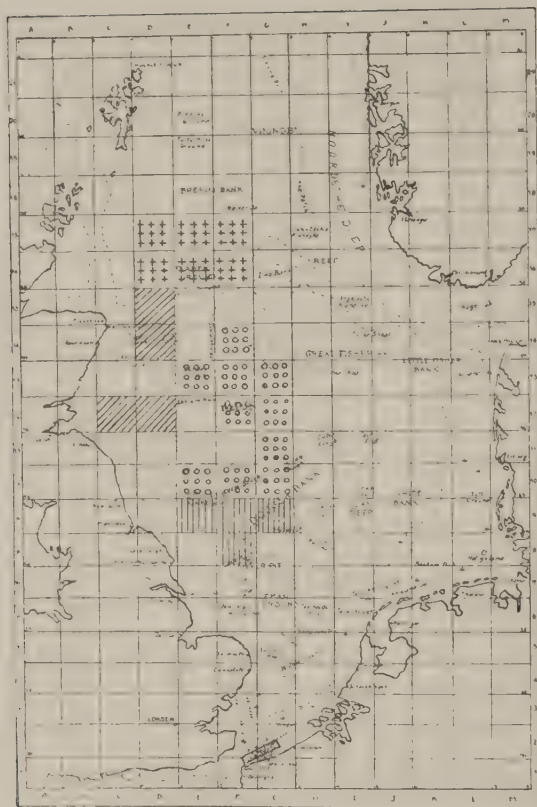
A comparison of the activity displayed by the herring trawlers with the results achieved during the post-war years, permits us to infer that the quantities landed in 1949 are in relation to the effort furnished by the herring fleet. Moreover, since 1947, the average catch per hour's effective fishing for 100 H.P. developed, seems to stay around 100 Kg.

If this level could be maintained in the future, the question of overfishing the herring stock of the North Sea would not be raised and the yield of the fishery would be sufficient to guarantee a lucrative exploitation, on condition however, that the prices offered be reasonable.

C. Biological Statistics.

(Material collected during August, September and October 1949).

In 1946, the results were distributed according to the origin of the material, namely Fladen and Gut. But as the information regarding the samples was later found not always



Fishing Grounds exploited by
Belgian Herring Trawlers in 1949.

Periods	Maturity Observed Stages	Mode
July-August-Sept.	I to VI	V
September	I to VII	V
Sept.-October	I to VIII-II	V
October	V to VIII-II	VI
November	V to VIII-II	VI

to be very trustworthy, we have given in 1947 and 1948, the distribution in monthly periods, viz. August, September and October.

However in 1949, we have been able to cover this deficiency, and therefore, in this present study, the results are distributed according to the origin as well as according to the periods.

Besides, we have proceeded with a third distribution, the one covering the most important racial characters (average of the total number of vertebrae, of the cervical vertebrae and of the keeled scales) for each stage of maturity.

The results obtained reveal once more the presence of two very distinct groups or populations: a first group, made up by spring spawners in maturity stage I, II and III, with a relatively high average of vertebrae (ca. 56.70) and a second group made up by "autumn spawners" in maturity stage IV to VIII—II with a remarkably inferior average of vertebrae (ca. 56.50).

The material comprises 22 samples from 50 to 90 herrings each, forming a total of 1320 herrings: 690 herrings from the northern area, chiefly the Fladen Ground (August-September), and 630 herrings from the central area, chiefly Turbot Bank, Old Devil Hole, Gut, Dogger Bank and Bruceys Garden (September-October).

The census for the vertebrae covered 1320 spines, of which there were 25 spines or 1.89 % with fused vertebrae. These spines have been eliminated from our material.

Stomachal Contents.

Among the 1320 stomachs examined 73 or only 5.53% were found to have any contents: 6 full and 67 half full. The contents observed consisted for the greater part of copepods and smaller quantities of schizopods. Besides, stomachs have been found to contain eggs and keeled scales of herrings, which have most probably been swallowed during the trawling or during the winding up of the nets.

D. A few Considerations on the Biological Values observed.

The fishing grounds according to the various months have been given under A, p. 183. A comparison of the monthly results shows that the material collected in August and September differs hardly or not at all, whereas the results concerning the material assembled in October

Table 17. Values observed during the Periods
August-October.

Characters observed	Material assembled in:		
	August	Sept.	October
Average size in mm.	275	275	262
Average weight in gr.	165	160	136
Quantity of Fat 0 %	14.1	36.0	51.9
1 %	49.3	46.7	47.3
+ %	14.3	6.9	0.4
M %	22.3	10.4	0.1
Maturity stages (I to III) % ..	9.3	5.9	0.4
Maturity stages (IV to VIII-II) %	90.7	94.1	99.6
Most frequent year-class	1941	1942	1945
	(8 years)	(7 years)	(4 years)
Vertebral average	56.53	56.57	56.49
Average of the keeled scales K_s	14.79	14.76	14.87

Table 18. Cervical Vertebral Average observed for each Total Number of Vertebrae.

Concentrations	Total number of vertebrae							Number of spines obs.
	54	55	56	57	58	59	61	
Full Herring number	4	32	301	273	33	—	—	643
1946 average	22.8	23.4	23.6	24.0	24.2	—	—	
Spent Herring number	1	8	157	200	32	1	1	400
1946—47 average	24.0	23.9	23.8	24.1	24.4	25.0	28.0	
Full Herring number	3	45	440	449	60	3	—	1,000
1947 average	23.0	23.3	23.8	24.1	24.6	24.7	—	
Spent Herring number	2	47	425	517	58	1	—	1,050
1947—48 average	23.5	23.0	23.7	24.0	24.7	24.0	—	
Full Herring number	4	39	400	483	71	3	—	1,000
1948 average	22.5	23.4	23.7	24.1	24.2	25.0	—	
Spent Herring number	5	58	434	512	88	3	—	1,100
1948—49 average	22.4	23.4	23.7	24.1	24.4	25.0	—	
Full Herring number	—	38	598	593	62	4	—	1,295
1949 average	—	23.3	23.8	24.1	24.4	23.8	—	
Total number	19	267	2755	3027	404	15	1	6,488
average	22.8	23.3	23.8	24.1	24.4	24.5	28.0	

deviate remarkably from those observed the previous months (see Table 17).

The figures in Table 17 are very instructive on this point and they indicate that the extreme values observed are always found in August and October, except the vertebral average, which attained its maximum value in September, month in which the other values approach those of August. Nevertheless they constitute intermediary values between August and October.

From this we infer that from October onwards, the full-herring concentrations exploited by the Belgian trawlers in the central area of the North Sea had already undergone a rather extensive modification in their composition and that the critical moment of this change takes place in the second fortnight of September or in the areas south of 55° or 56° L. N.

Note also, that the proportion of herrings of the first group (maturities I, II and III) was very poorly represented this year, viz. 5.1% against 28.7% in 1948, 22.1% in 1947 and 11.2% in 1946. As in previous years, this group was missing in our samples from October.

It is also interesting to note, that for the period August-September, the year-class 1945 (4-year-old herrings) barely reaches 3.4% of the total number of individuals observed, whereas in October it is the best represented year-class with 18.6%. This same year-class was also abundantly represented in the "Spent-Herring Concentration" on the Belgian coast during the Winter 1949—50.

The vertebral average, which was 56.57 in September, decreases suddenly to 56.49 in October.

For the spring spawners (1st group), this average is 56.735, for the autumn spawners (2nd group) 56.515 and together 56.533.

At the time of the Herring Experts Meeting at Edinburgh, we have insisted on the relation existing between the total number of vertebrae and the total number of cervical vertebrae, that is to say, that the spines constituted of a large number of vertebrae also have a relatively high proportion of cervical vertebrae.

Thus, the cervical vertebral average of a lot of spines with 56 vertebrae, will inevitably be higher than the one with spines of 55 vertebrae. Again, the cervical vertebral average of spines with 57 vertebrae will be superior to the one with spines of 56 vertebrae, etc.

This point of view is again confirmed in this present study.

Table 18 gives a recapitulation of the cervical vertebral averages observed for each total number of vertebrae of the years 1946—49 for the "Full-Herring Concentrations" of the northern and central areas of the North Sea as well as for the "Spent-Herring Concentrations" on the Belgian coast.

The results unquestionably show, that an increase in the total number of vertebrae entails also an increase of the number of cervical vertebrae.

Therefore, the latter value seems to be of little interest for the study of the different populations, which may be met with in the future, and we suggest not to take any more notice of it in our ulterior studies.

C. Central and southern Kattegat, Belt Sea and Baltic.

1. YOUNG STAGES

Larvae in Danish Waters.

In 1949 the following numbers of herring larvae were caught in 2 m. ring-trawl pr. 1 hour in the various areas. In brackets: mean for 1935—39.

Area	May		October		November	
	No. of Stat.	Herring	No. of Stat.	Herring	No. of Stat.	Herring
N. Kattegat	0	—	0	—	5	200 (—)
C. »	0	—	0	—	5	139 (—)
S. »	10	5.6 (8.8)	4	0 (21)	8	34 (—)
Sound	8	2.5 (2.0)	4	0 (22)	0	—
Belt Sea	5	2.2 (2.8)	10	0.6 (68)	1	42 (—)

In April a mean of 4.7 were taken at 20 stations in the Belt Sea (in 1935-38: 7.3).

The mean number of herring larvae from winter and spring spawners was about normal both in the months of April and May. In October there were very few herring larvae, considerably below normal, but in November several autumn herring larvae were caught, especially in the northern and central Kattegat. From previous years we have no observations for the month of November, so nothing can be said about the normal number of herring larvae in that month.

J. B. KIRKEGAARD.

2. COMMERCIAL FISH

Herring in the southern Kattegat, the Belt Sea, and at Bornholm.

The southern Kattegat and the Belt Sea.

Among the samples of young herring taken in the southern Kattegat and the Belt Sea (Table 1) one consisted of about 1-year-old herring caught in Århus Bay on 27/10-1948 which were Kobbergrund herring (deep-water autumn spawners from the northern Kattegat) while in all other samples the ca. 1-year-old herring no doubt were mixtures between North Sea autumn spawners and Kobbergrund herring and spring spawners from the Kattegat or the Belt Sea. Some of them (from 9/2, 21/2, 7/3 and 17/3 1949) show almost the racial characters of the North Sea autumn spawners, others those of the southern Kattegat and Belt Sea spring spawners. If the combinations V.S.—V.P. of the samples are drawn up in a diagram presenting these characters of mature herring it will be easily seen that

the Kobbergrund herring which have a V.P. of 24.3—24.6 cannot be the only component with the higher values of these characters, but that North Sea autumn spawners must be found at any rate in some of the mixtures. Most of the approximately 2-year-old herring in two samples from the southern Kattegat (21/12-48 and 7/3-49) and at Assens (southern Lillebelt) seem to be spring spawners from the northern Kattegat, and in a sample from the Isefjord (26/10-48) were pure coastal spring spawners from the southern Kattegat or the Belt Sea. The older herring of the Isefjord sample of maturities III—V and the spawning and just spent herring of the Assens sample, which are coastal winter spawners of the area, differ from the spring spawning herring in their somewhat high K_2 .

The fat content of the samples was generally decreasing from October to March, the lowest values being found in February, March and April (see Table 1).

The stomachs of most samples were empty; in the Isefjord sample 70% of the herring were empty, the other contained Mysidae and *Palaeomon fabricii*; in the samples from 17/3 and 11/4 the stomachs were filled with copepods.

Table 1. Length, Racial Characters and Fat Content of trawl-caught Herring.

(Numbers in brackets).						
Date, Year	Mean length cm.	V. S.	V. P.	K ₂	Fat %	
Southern Kattegat						
1948						
21/12	19.7	56.33 (120)	23.98	14.25 (114)	8.2	
1949						
7/3	ca. 15	56.33 (52)	23.94	14.73 (55)	1.3	
	ca. 19	56.03 (150)	23.69	14.94 (151)	4.5	
The Belts						
1948						
19/10 . . .	14.1	56.16 (123)	24.39	14.20 (121)	13.6	
27/10 . . .	15.4	56.34 (122)	24.32	14.55 (119)	6.6	
30/11 . . .	13.3	56.11 (132)	23.90	14.69 (90)		
16/12 . . .	14.0	56.08 (114)	24.05	14.24 (114)	12.0	
1949						
3/1	13.0	56.24 (124)	23.92	14.41 (113)	3.7	
18/1	14.2	56.20 (146)	24.00	14.50 (140)	3.8	
9/2	13.8	56.35 (117)	23.95	14.51 (116)	2.1	
21/2	15.1	56.33 (126)	23.91	14.56 (113)	2.6	
17/3	ca. 14	56.43 (143)	24.03	14.62 (114)	2.8	
11/4	ca. 14	56.30 (125)	23.90	14.59 (82)	0.7	

At Bornholm.

**Trawl-caught Herring ca. 15 naut. miles W. of
Rønne, Bornholm, on 10/5-1949.**

Length — Maturity, percentage					
Maturities (intern. scale)					
cm.	I	II-III	IV-V	VII-VIII	Total
19	3	—	—	—	3
20	2	—	4	1	7
21	4	3	3	1	11
22	1	8	3	6	18
23	—	6	8	16	30
24	—	2	3	20	25
25	—	—	2	4	6
	10	19	23	48	100

Total analysed 119, only measured 68.

Rings — Maturity, percentage					
Maturities					
Rings	I	II-III	IV-V	VII-VIII	Total
1	1	2	1	—	4
2	3	1	—	—	4
3	3	3	1	2	9
4	1	3	5	5	14
5	—	1	5	8	14
6	—	4	3	15	22
7	—	2	3	8	13
8	—	1	3	3	7
9	—	1	—	2	3
10	—	2	2	5	9
11	—	—	—	1	1
	8	20	23	49	100

Racial Characters (numbers in brackets)

	V. S.	V. P.	K ₂
fat, I-II-III.....	55.66 (32)	23.69	13.90 (31)
» IV-V-VII-VIII...	55.65 (86)	24.35	14.11 (84)

The racial characters of the 27 herring of maturities IV and V were the same as those of the 59 of maturities VII—VIII, but the material is naturally too small to show if this is really the case. A noticeable difference is found between the immature and the mature and spent. The immature seem to be mixtures of spring and autumn spawners, the others have the racial characters of autumn herring, but their V.P. and K₂ values are more similar to the Hanöbay herring than to the Bornholm herring. The V.S. is rather high for both of these races.

The fat content of the herring of maturities II—IV was 7.1% and of maturity V 8.4%, which are rather high values for the season but corresponding to the great fat content of the plankton (see p. 158).

The fishery. According to the reports from the fishery control to the Ministry of Fisheries the catches in nets in the autumn were very varying. This corresponds with the spotty occurrence of the plankton (see p. 158).

AAGE J. C. JENSEN.

Baltic Herring.

The herring fishery in the *southern Baltic* (Bornholm area) was still very good, and the catches in the drift-nets have increased rather much in recent years. The yield of the trawl fishery was also good, especially in the summer. It is quite astonishing, that the autumn spawners from 1937 in 1949 still formed an important part of the catches. In Fig. 1 the age-distribution of some catches from May 1949 is shown. No less than 41% of the herrings in these catches belonged to the 1937 year-class. The younger year-classes were remarkably weak. The occurrence of 8-year-old herrings is rather enigmatic, as this year-class never before has been strong in the catches from the Bornholm area. In the spring 1945 I had the opportunity of investigating the stock of herring off Trelleborg at the southern coast of Scania. The large herrings, mainly of the 1937 year-class had then decreased rather much, and were in this area replaced in the catches by young herring from the beginning of the 1940's.

In the waters east of Scania and Bornholm very little was then seen of these year-classes. It may be possible that the occurrence of these age-groups in the catches in the Bornholm area now is the result of a migration of older

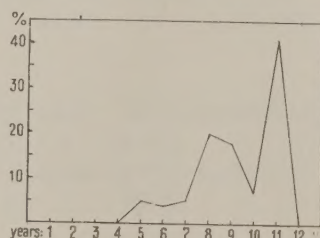
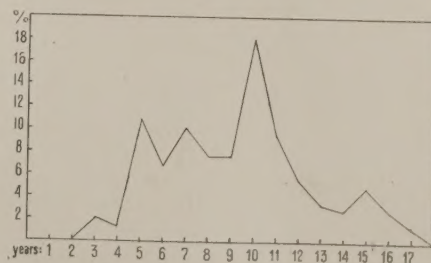


Figure 1.

Figure 1. Herring (trawl catch).
Southern Baltic, May 1949.Figure 2. Herring (trawl catch).
Sea of Bothnia, September 1949.

herring from the western shallow parts of the southern Baltic to the deep Bornholm Basin.

The herring fishery in the *central Baltic* was good in the winter 1948—1949. The rich year-classes of young herring, reported in the experimental catches in 1947 and 1948 are now of great importance for the commercial fishery, but no noteworthy changes in the composition of the stock have been observed in the last year.

Judging only from the catches made with drift-nets and anchored nets one gets the impression that the rich year-classes 1943—1946 of spring spawners at present form the principal part of the stock of herring in the *Gulf of Bothnia*. The bulk of the commercial catch is made with these implements in this area. In 1949, however, experimental trawling was performed on an extended scale, principally in comparatively deep water, and the

catches obtained at these experiments were quite interesting. The age-composition of some of these is shown in Fig. 2. The old herrings that, as a rule, are found only very seldom in the net catches, form in fact the chief part in the trawl catches. As I have pointed out before (*Ann. Biol.*, Vol. II, p. 172) the catches of herring in greater depths in the Baltic often show a mixture of different "races". To judge from the types of the scales and the maturity stages the trawl catches in 1949 contained spring spawners (ice-herring), autumn spawners and herrings that perhaps may be rated as summer spawners. A closer analysis of the catches as to racial characters has not yet been made. The catches, however, allow us to draw the conclusion that the fishery in the Sea of Bothnia makes no full use of the stock of herring, since a great deal of the stock obviously can attain a very high age.

H. ALANDER.

Corrigenda

page 53

2nd column, The Cornish Pilchard, Length; 5th line,
read: 20.3 cm., instead of: 230 mm.

page 112

Environment, Hydrography; 5th and 6th line,
read: this line in 1949, when it occurred from April to July,
in 1948 in January and in 1947 in March. Average summer
instead of: this line only in 1949, when it occurred in June
and July in the central part. Summer

2nd column; 2nd and 3rd line,

read: Lat. $56^{\circ}22'N$. Long. $06^{\circ}00'E$., a value of $21.8^{\circ}C$.

instead of: Lat. $50^{\circ}22'N$. Long. $07^{\circ}00'E$., a value of $21.5^{\circ}C$.

2nd column, Plankton; the last 3 lines,

read: the dry weight and the fat-content declined steadily
from 1947 to 1949.

instead of: the dry weight was highest in 1947 and least in
1948, the fat-content declining steadily from 1947 to 1949.

page 114

Hull-Hanstholm 1947, Salinity.

Station 5 in June; read: 34.61, instead of 43.61

Station 1 in December; » 34.57, » » 34.59

page 131

1st column, 1st para.; line 22, read: 75% , instead of 83%

2nd » ; » 5, » : 13.6% , » » 13.4%

2nd column, 1st para.; line 4, read: 2.9% , instead of 29%

2nd » ; » 5, » : 97% , » » 98%

